



ANNUAL REPORTS

OF THE

DEPARTMENT OF AGRICULTURE

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REPORT OF THE
SECRETARY OF AGRICULTURE.
DEPARTMENTAL REPORTS.

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REPORT
OF THE
SECRETARY OF AGRICULTURE.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

TO THE PRESIDENT:

The Department of Agriculture has reached farther into sympathy with the industries of the people during the past year. It has identified itself more intimately with the experiment stations of the several States and Territories and what pertains to the interests of their people. It has gone farther in foreign lands to find many things that will be valuable to our producers. The grouping of related sciences into Bureaus has economized time and contributed to efficiency. The process could be advantageously extended to other Divisions and Offices that are growing beyond their present environment.

The education of student assistants and scientific aids in their several specialties goes on satisfactorily under the scientists in charge, giving promise of high efficiency in the future personnel of the Department.

NEW BUILDING NEEDED.

The growth of the Department causes continual overflow into rented buildings that now cost over \$10,000 a year. This, and the danger of loss by fire of material that has been accumulating for years and could not be replaced, induced the Congress to appropriate \$5,000 at its last session to provide for the selection of an architect and plans for a new building, which has been done with the cooperation of the Architect of the Treasury, under whose direction a commission was selected to pass upon the drawings, consisting of Messrs. D. H. Burnham, C. F. McKim, Augustin Saint Gaudens, F. L. Olmsted, jr., and James Knox Taylor, and a report upon the action taken will be submitted to the two Houses of Congress at an early date.

OUR DUTY TO NEW POSSESSIONS.

The extension of American jurisdiction over islands in the Tropics brings new problems to the student of agricultural science. We buy annually over \$400,000,000 worth of the products of foreign fields,

one-half of which will, at no distant period of time, be grown in the United States; the other half is the product of such climates as prevail in our new island possessions. It is the privilege and duty of the Department of Agriculture to teach the people of those islands to produce what we now buy from tropical countries, that they may have incomes to help toward their growth in all desirable directions.

The topics discussed in the reports of the Bureaus, Divisions, and Offices of the Department are indicated in the following brief paragraphs:

SUMMARY.

THE WEATHER.—The Weather Bureau has established cooperation with Europe in the interchange of weather forecasts. The farmer in the country is receiving his weather forecasts with his mail through rural free delivery. Progress is being made in perfecting wireless telegraphy.

ANIMAL INDUSTRY.—Our animals are the healthiest in the world, and the people at home and abroad are protected by the inspection of meats in 51 cities and 156 abattoirs. Exports of animals and animal products amount to \$253,000,000. Imported animals are inspected. Animal diseases are being eradicated by serums and vaccines sent out from the Department. State restriction of interstate traffic in live stock is in the courts.

PLANT INDUSTRY.—The diseases of cotton and other plants are being investigated. Plant breeding to obtain forms that will resist disease and be better adapted to new and changed conditions is being successfully carried on. A new method of cultivating and distributing the seeds of bacteria that cooperate with leguminous plants in developing nitrogen has been discovered. Antidotes for many poisonous plants have been found. Improved methods of curing grass seeds have been put in operation. Experiments with clover seeds show the superiority of the American over the foreign kinds. Tropical agriculture is being studied and the people of our island possessions are being taught better methods of growing coffee and other plants. The improvement of grasses on the Western ranges is being studied. Cooperation is had with most of the experiment stations about the country. Markets for our fruits are being successfully opened in foreign countries. The hop, prune, and other industries of the Pacific coast are being helped by the Department's investigations and importations. The Arlington farm is being brought into condition for use. Satisfactory results are being obtained from tea cultivation. Macaroni wheats are being successfully grown in our semiarid localities. Superior barleys for commercial purposes have been introduced. Egyptian cottons are being successfully grown, and the importation of the date palm has been a success. The Congressional seed distribution has been reorganized.

SOILS.—The Bureau of Soils is a necessity to find suitable soils for the new plants introduced, as well as the soils most suitable for our staple crops. Sumatra tobacco is being successfully grown in the Connecticut Valley and in Florida. Experimentation is being conducted in Pennsylvania in the growing of Havana filler tobacco, and this will be extended to Ohio, Texas, and the island possessions. The growers of the several fruits, table vegetables, and sugar beets, both

East and West, are being helped by the finding and mapping of suitable soils. Soil surveys are of benefit to Western irrigated districts. State organizations are cooperating in soil investigations, and these will be extended to the island possessions to help them in producing what can not be grown in the United States. Extensive areas of alkali lands in the mountain States are being reclaimed in cooperation with the Bureau of Soils. New processes of tobacco fermentation avoid losses by black rot.

CHEMISTRY.—The composition, nutritive value, and adulteration of food products are inquired into, and extensive work is done in the study of food preservatives. Much work has been done in the investigation of the adulterations of imported food products, and the results will soon be given to the public. The chemistry of woods is studied in cooperation with the Bureau of Forestry. A special study is made of the problems relating to sugar-producing plants. The physical and chemical study of road materials is now established in the laboratory. Work is done in the laboratory of this Bureau for all Departments of the Government.

FORESTRY.—The study of forests, forest fires, forest grazing, commercial trees, lumbering, and forest products for the Federal and State governments and for private individuals is included in the work of this Bureau. Tree planting for wood lots, shelter belts, and commercial plantations is a prominent feature. Assistance is given to the Interior Department in the study of the scientific work of the forest reserves. This Bureau is getting into close touch with all the forest interests of the country. Over 52,000,000 acres of forest lands throughout the United States are under its consideration. Commercial lumber companies in all parts of the country are asking help in the management of their properties. An Appalachian forest reserve, to protect the headwaters of important Southern streams, is recommended. Investigations to improve the methods of turpentine orcharding are being conducted.

EXPERIMENT STATIONS.—Inquiry shows that the experiment stations of the several States are working in the interest of their respective localities. Satisfactory progress is being made and the States are more liberal in helping the stations. The Department of Agriculture is cooperating extensively with the stations. Satisfactory reports come from the work in Alaska, which the people there are appreciating. Progress is being made in the establishment of experiment stations in Hawaii and Porto Rico, and there is much need of a beginning in the Philippines. Improvement is suggested in agricultural education. The farmers' institute work might be assisted. Interest grows in the study of the nutrition of man. Economy in the feeding of the human family would promote health and save money.

Irrigation.—The irrigation laws of the States have been studied and investigations made of the methods by which water is conserved, distributed, and used. The titles to water should be better understood and the disposal of water should be safeguarded. The Department's investigation is suggesting the enactment by the States of new and more intelligent legislation. The people interested should sanction all innovations, and they should be helped to do what localities can not do. Extensive irrigation works, such as the damming of large rivers, should be built by the Federal Government.

ENTOMOLOGY.—This Division has completed its work with the fig-fertilizing insect and has written up its history. Probably 75 tons of figs fertilized in this way will be put on the market this year. The original home of the San Jose scale has been found, after long investigation in the Orient, to be in northern China. The beetle that preys upon it is being brought in considerable numbers to the United States for distribution to orchards. The scale was found near the Great Wall, where no foreign nursery stock of any kind had ever been introduced. Its natural enemy keeps it in such check there that the native fruits grow successfully. After eight years of effort success has been reached in the introduction into the United States of a caterpillar from Italy that preys upon the black scale, a serious enemy to olive and citrus trees in California. This scale is a native of the region from which the caterpillar has been introduced, and along the shores of the Mediterranean the latter keeps the scale in subjection. A beetle has been introduced from Hungary that is a natural enemy to several destructive plant lice which have been accidentally imported into this country from Europe. A fungous disease of grasshoppers has been imported from South Africa and experimentally used in different parts of the United States through the summer of 1900-1901. In some localities it appears to have taken hold successfully.

Other work of this Division may be summarized as follows: During the past year the insects affecting the violet, the rose, and other ornamental plants have been studied. Work has been done in cooperation with the Bureau of Soils looking to the eradication of mosquitoes. A study of flies has indicated the importance of these creatures in the carriage of internal diseases. Systematic work is being projected to deal with the cotton-boll weevil of Texas.

PUBLIC ROADS.—This Office studies the condition of the roads, publishes information with regard to their improvement, the obstacles in the way, and the best means of securing better highways. Object-lesson roads have been built in nine States during the past year. The laboratory for testing the chemical and physical properties of road materials, conducted under the direction of the Bureau of Chemistry, has been in successful operation during the year. An agent of the Department is located in each of four geographic subdivisions of the United States to study and report upon local conditions.

PUBLICATIONS.—The work of this Division affords a fair reflex of the activity of the Department. During the year 1901 there were issued 606 publications, aggregating nearly 8,000,000 copies. Of these, 3,345,000 were Farmers' Bulletins. The Yearbook of the Department continues to be in great demand. Many of the Department's agents throughout the country receive no compensation except copies of our publications. A larger number of the Yearbook should be assigned to the Department. The publications of this Department are in demand among the people. The agent who sells governmental documents shows that during 1901, 24,127 copies of publications from this Department were sold, as against 9,458 from all other Departments. Congress at its last session greatly increased the number of Farmers' Bulletins to be printed and furnished to Members. A sufficient amount of money for their publication and distribution was not appropriated.

FOREIGN MARKETS.—Agriculture contributed conspicuously to the expansion of American commerce during the past year. The highest

record attained in the exportation of agricultural products previous to last year was surpassed by more than \$90,000,000 for the fiscal year 1901, when a value of over \$950,000,000 was reached. Fully 65 per cent of domestic merchandise sent abroad during that year originated on the farm. The most important foreign markets for our surplus products are in the United Kingdom, Germany, France, the Netherlands, and Belgium. We sent to Cuba, Porto Rico, and the Philippine Islands in 1901, \$18,600,000 worth of exports, being about 53 per cent of their receipts in those islands. They are increasing in Porto Rico and the Philippines, and declining in Cuba. Our imports from these three island groups increased from \$36,162,000 in 1900 to \$48,600,000 in 1901, the bulk of the gain being in the imports from Cuba. Of the \$70,000,000 worth of domestic merchandise exported from the Pacific coast during the fiscal year 1900, \$45,000,000 worth consisted of farm produce.

LIBRARY.—We have the most extensive agricultural library in the country. Four thousand books and pamphlets were added during the past year. Reference lists with regard to publications on land drainage, tobacco, etc., have been prepared. The constantly broadening field of investigation makes increased demands upon the Library, and it is necessary that our scientists have access to the work done at home and abroad. The agricultural colleges and experiment stations are drawing upon the resources of the Library to assist them in special work. An increased appropriation to permit of the engagement of scientific aids in library work is much needed. The Library room, like the other quarters of the Department, is entirely inadequate.

ACCOUNTS AND DISBURSEMENTS.—Congress appropriated \$3,303,500 for the Department for the fiscal year ended June 30, 1901. Final payments will amount to about \$3,200,000. Owing to inadequate accommodations in the Department proper, our rentals for outside buildings for the fiscal year 1902 will exceed \$10,000.

BIOLOGICAL SURVEY.—This Division is engaged in mapping the boundaries of the natural crop belts of the country, and aims to furnish the American farmer with lists of crops likely to succeed in different parts of the country. The work has been done in Texas and California to a great extent during the past season. A fiber plant has been discovered that grows over 20,000 square miles of land in Texas, and the Biologist thinks that the fiber of this plant may take the place of over \$12,000,000 worth of the fiber of other species of agave annually imported, mostly from Mexico. The fog zones of California mostly run north and south, owing to the trend of the mountains, and interesting deductions for fruit growers are reached. The prairie dog of the great plains that stretch from Montana and the Dakotas into Texas is increasing rapidly, owing to the destruction of its natural enemies, to the serious injury of pasture grasses. Field experiments are being conducted looking to its destruction.

Observation of birds in southern California shows that two of them feed extensively on the olive scale. The large blackbirds of southern Texas that feed on crayfish which cut the rice plant and on the cabbage worm have been slaughtered in great numbers for the millinery trade. These studies in ornithology have a direct bearing upon crop production. Farmers' Bulletins on these topics are being distributed in large editions. This Division is charged with the supervision of

matters relating to game protection and introduction and executes the Lacey Act. It gives permits for the importation of birds and supervises their movement in interstate commerce. This service will be extended to Hawaii in the coming year. More liberal appropriations are required to carry on the valuable work of the Biological Survey.

STATISTICS.—The Division of Statistics has 250,000 reporters located throughout the United States, who furnish facts monthly regarding the crops. Its work consists in the preparation of reports relative to the principal products, the condition and prospects of the crop during the growing season, and the quantity, quality, and disposition of the product harvested. There is urgent necessity for extending this work to other products, such as live stock, fruits, sugar, rice, etc. Agents are already organized to collect the facts, and only the addition of a sufficient number of compilers to collate and analyze these facts is necessary to the extension of the work. Negotiations with foreign governments, looking to the telegraphic interchange of crop reports, have been undertaken. The statistician has had marked success in estimating the cotton and other crops during the last few years.

WEATHER BUREAU.

NEW OCEAN FORECASTS AND INTERNATIONAL COOPERATION.

An important extension of the forecast work of the Weather Bureau has been made during the year. By an arrangement with the secretary of the meteorological office at London, England, the transmission by cable from London to Washington of meteorological reports from certain points in the British Isles and on the Continent of Europe, and from Ponta Delgada, Azores, was begun December 18, 1900. These reports, with observations from Nassau, Bermuda, and Turks Island, have been regularly published on the daily weather maps issued at Washington, Baltimore, Philadelphia, New York, and Boston, together with forecasts of the force and direction of the wind and the state of the weather for the first three days out of steamers bound east from American ports.

The Atlantic forecasts, which are based on the American, Atlantic, and European telegraphic reports, were begun January 7, 1901, and on June 1, 1901, they were made a part of the regular general night forecasts issued at Washington. In a number of instances, when storms of marked strength were passing eastward off the American coast, forecasts were issued of the character of the weather which would probably be experienced by steamers leaving European ports westward bound, and by an arrangement with Lloyd's, of London, these advices have been cabled to England.

In addition to the daily forecasts of wind and weather and special storm warnings, predictions of fog have been issued when conditions favorable for fog development have been indicated in the steamer tracks west of the fiftieth meridian. Reports from trans-Atlantic

steamships show that these forecasts and special warnings have been well verified.

In November, 1900, arrangements were made with Portugal to receive reports from the meteorological observatory at Horta, in the Azores. Observations are now regularly received by cable from that place, and they are of much value in the work of forecasting the movements of storms on the Atlantic Ocean.

THE GALVESTON HURRICANE.

The principal storm of the year was the West Indian hurricane which devastated Galveston, Tex., September 8, 1900. This was one of the most destructive storms on record. Upward of 6,000 human lives were lost, and property to the estimated value of \$30,000,000 was destroyed.

The wisdom of Congress in appropriating for the establishment of weather stations in the West Indies was well demonstrated by the warnings that were issued well in advance of this storm, from the time of its inception in the Caribbean Sea to its arrival at Galveston, and thence throughout its course to the Great Lakes and onward to the Atlantic Ocean.

NEW FORECAST DISTRICTS.

Three additional forecasting districts have been established and designated as the New England district, the West Gulf district, and the Rocky Mountain district, with headquarters at Boston, New Orleans, and Denver, respectively. The last appropriation bill passed by Congress made provision for three additional forecast officials to be placed in charge of these districts with authority to issue forecasts and warnings for the several States that are comprised in each district. This system has the advantage of enabling the forecaster to devote more time to the consideration of the predictions for each State and of securing an earlier distribution of forecasts. As these forecast officials were selected on account of their ability as forecasters for their respective sections, it is expected that an improved service will result.

IMPROVEMENT IN FORECASTS.

Special consideration has been given to the subject of increasing the accuracy of the forecasts of the Weather Bureau to the highest degree attainable, and as a means of stimulating among the employees of the Bureau the study of the problems of weather forecasting announcement has been made that hereafter marked success in forecasting, the invention of new methods of forecasting, or the discovery of new facts

or principles of marked value to the forecaster will have a special weight in considering the merits of employees of whatever grade for promotion.

RECENT EXTENSION OF WEATHER SERVICE.

It is a wonderful picture of atmospheric conditions that is now presented twice daily to the trained eye of the weather forecaster. In addition to the reports from Europe, the Azores, and Bermuda, the field embraces an area extending from the Atlantic to the Pacific, from the north coast of South America over Mexico, the islands of the West Indies and the Bahamas, northward to the uttermost confines of Canadian habitation. It is a panoramic picture of the exact air conditions over this broad area that is twice daily presented to the study of our experts. Hurricanes, cold waves, hot waves, or rain storms are shown wherever present in this broad area. Their development since last report is noted, and from the knowledge thus gained their future course and intensity is quite successfully forecast. Every twelve hours the kaleidoscope changes, and a new graphic picture of weather conditions is shown. Nowhere else in the world can meteorologists find such an opportunity to study storms and atmospheric changes.

CLIMATE AND CROP WORK.

The lines of work pursued in previous years by the climate and crop service of the Weather Bureau were continued and extensions and improvements made wherever possible. The cotton-region service has been extended into Oklahoma and the Indian Territory, and arrangements have been made for inaugurating a similar work in California, to be known as the fruit and wheat service.

FORECASTS TO FARMERS BY RURAL FREE DELIVERY.

Particular attention has been given to the distribution of forecasts by means of the rural free delivery. There are now in operation 365 centers, supplying an aggregate of nearly 42,000 families in the farming districts with the latest weather predictions. This work has become decidedly popular, and we have had the hearty cooperation of the Post-Office Department in making it a success. With some additional appropriation, it is the intention to reach several hundred thousand farmhouses with the daily forecasts and warnings during the coming year. The value of frost and cold-wave warnings to rural communities is beyond estimate, and the rural free delivery of the Post-Office Department places the means at our command of reaching those who can be the most benefited by these warnings.

WIRELESS TELEGRAPHY.

The vast extent of our sea and lake coasts and the intimate communication between the Weather Bureau stations of this Department, which are distributed along these coast lines, and the vessels of commerce have induced me to authorize persistent and systematic experimentation in etheric space telegraphy. Substantial improvements have been made during the past year in the Department's system.

The line of research has been divided into three classes: First, the perfection of a more powerful transmitter, in which the energy of radiation shall be greatly increased; second, the devising of a more delicate receiver—one that would be positive instead of depending upon an imperfect and variable contact, as do all systems now in use; and, third, the perfection of a system of selective telegraphy whereby messages may be differentiated and only the receiver that it is desired shall receive the message may become responsive to the waves of ether.

The first of these problems may be said to have been successfully solved, and a transmitter devised capable of radiating all the energy generated. The second is believed to be nearing a successful solution. The third is thought to be well demonstrated theoretically, but has not been fully tested in practice.

While there is much experimental work yet to be done before the present system is reliable for intership communication, or before any two systems can work within the same field without each rendering the other useless, such progress has been made by the Government experimenters that, with no interference by private systems, stations can be successfully operated over at least 150 miles of coast line, and they are now in operation on the North Carolina and Virginia coasts, and soon will be instituted between the Farallone Islands and the mainland and Tatoosh Island and the mainland, on the Pacific coast.

THE MERIT SYSTEM AND THE DISCIPLINE OF THE WEATHER BUREAU.

The merit system of the Weather Bureau conforms to the letter of the Civil-Service law and carries its spirit to a rational and beneficent conclusion. The duties of this Bureau are exacting. It requires a strict discipline to administer a service with such extensive ramifications and have every man at his post of duty at exactly the same moment of time, and to do this several times each twenty-four hours, as is necessary in the gathering and the charting of simultaneous weather observations and in the rapid dissemination back to the country of the forecasts and warnings based upon the observations.

A system of merit and discipline has gradually become fixed in the Bureau. The system is fair. It enables honest and efficient officials to

work themselves upward without placing themselves under obligations to anyone. It contributes to a high standard of manly character and to efficiency in public office.

BUREAU OF ANIMAL INDUSTRY.

Our animal industry, which has been most remarkably developed both as to numbers and values, has experienced great prosperity. There has been an active market for animals and animal products at satisfactory prices. In no other large stock-raising country have animals been so free from disease. It is the function of this Department, through the Bureau of Animal Industry, to foster and assist this branch of agriculture by distributing information, by protecting it from both imported and indigenous contagion, by inspecting animals and meats for the interstate and foreign trade, and by certifying that exported meats are wholesome and that animals are free from contagion.

ANIMAL EXPORTS.

Under this intelligent and helpful supervision there were exported last year animals valued at more than \$52,000,000, meats valued at more than \$113,000,000, animal fats and oils valued at more than \$66,000,000, dairy products valued at nearly \$9,500,000, and miscellaneous animal products valued at more than \$12,000,000. The grand total of animals and animal products exported during the year amounted to nearly \$254,000,000.

INSPECTION SERVICE FOR EXPORT ANIMALS.

Out of a total of 459,000 cattle exported, there were inspected, marked with numbers for identification, and certified 385,000. The remainder were shipped in small lots from ports where no inspection is maintained and to countries which do not require inspection. The number of sheep exported reached about 298,000 head, and of these 228,000 were inspected before shipment. The horses and mules constituted the second largest item in the exports of live animals, the number being 116,500 and the value about \$8,900,000. Of these, nearly 48,000 were inspected and certified. There was a notable increase in the number of cattle and sheep exported, the former being greater than any year since 1898 and the latter the largest since 1896. There was a decline in the exports of horses.

The inspection of steamships which is made in connection with the inspection of export animals has been conducted with a view to securing strong and reliable fittings properly fastened to the decks, adequate ventilation, alleyways sufficiently wide to enable attendants to perform their duties in all kinds of weather, and, in general, such arrangements and management as would insure humane treatment and

land our animals in the best condition for market. The percentage of loss in ocean transit has been reduced to 1.72 for horses, 0.91 for sheep, and 0.24 for cattle. During the past year notable improvements have been obtained in the ventilation and width of alleys, and it is believed that the losses have reached almost the lowest attainable point. The number of clearances for vessels which were inspected and passed was nearly 1,000.

INSPECTION SERVICE FOR IMPORT ANIMALS.

In order to prevent the introduction of animal plagues an inspection service is maintained at our principal seaports and along our frontier. Quarantine stations have been established for animals coming from countries where contagious disease exists. There were quarantined at these stations during the year 559 cattle, 525 sheep, 81 swine, and 118 animals for menageries and zoological parks. There were also admitted, after inspection and in some cases quarantine, over 242,000 animals from Canada and about 100,000 from Mexico. The examination of this vast aggregate of imported animals, amounting in all to over a third of a million, is a most responsible task, but so far it has been successfully conducted, and none of the exotic plagues of the domesticated animals has been allowed to reach our territory. With our enormous investment in animals that are susceptible to such plagues, it is clearly a duty which the Government owes to our stock raisers to maintain this inspection and quarantine with the utmost rigidity. The ravages of the rinderpest as it is sweeping over the African Continent should be an object lesson indicating the terrible destruction which such a disease would cause among our immense herds of valuable stock.

The tremendous possibilities of loss from imported contagion suggest that possibly the time has come when it might be well for us to consider whether it would not be best for us to follow the example of Great Britain and exclude entirely live stock from other countries. Inspection and quarantine, however carefully and conscientiously performed, are acknowledged by most countries to be only a relative and not an absolute guaranty of protection. Should not our animal industry have the most complete safeguards thrown around it which the experience of the world has shown to be required for the most absolute and perfect protection? In this connection, we are reminded that some of the territory which has recently come under our flag is believed to be infected with animal plagues and parasites unknown to the United States, and that may work great injury if they are transported to our soil. It would appear to be wise for such legislation to be enacted as would provide against animals from this territory being allowed to enter our ports, whether these animals are brought by individuals or returning troops.

TUBERCULIN TEST FOR IMPORTED CATTLE.

The reported increase of bovine tuberculosis in most countries, and the losses already sustained from the disease in the United States, led me to make an order requiring a tuberculin test of cattle imported for breeding or dairy purposes. The application of this test has detected a sufficient number of diseased animals to fully justify its adoption. In fact, more animals have reacted than was anticipated, and in order to save importers from heavy loss it has been necessary to provide for this test before animals cross the frontier from Canada, and to send an inspector to Great Britain to make the tests and reject affected animals before shipment. In the tests which have been made it is not believed that any animals have been injured by the tuberculin or that any have reacted which were not tuberculous. The welfare of the live-stock interests requires the continuance of this method of inspection.

MEAT INSPECTION.

The meat-inspection service has grown to proportions commensurate with the live-stock industry. It is now maintained in 51 cities and at 156 abattoirs. Nearly 37,000,000 animals were inspected at time of slaughter. This is an increase over the preceding year of 6 cities, 8 abattoirs, and 2,300,000 animals. Although in the aggregate a large number of carcasses were condemned, the percentage has been extremely small. In nearly 5,250,000 cattle inspected the condemned carcasses amounted to only about one-fourth of 1 per cent; in 6,500,000 sheep it was about one-tenth of 1 per cent, and in 24,250,000 hogs it was but one-third of 1 per cent.

The larger part of the inspected meat, as might be anticipated, went into interstate commerce and was consumed in the United States, but there were exported under Department certificates 452,830,373 pounds of beef, 894,648 pounds of mutton, and 231,144,938 pounds of pork. The microscopic inspection of pork was maintained during the year, but owing to the comparatively high prices in this country there was a considerable decrease of exports in this line of products, but 35,942,404 pounds having been certified for countries requiring such inspection.

CONTROL OF INDIGENOUS DISEASES.

There are a few diseases which are more or less distributed over our territory and which require constant supervision and control. One of the most important is Texas or malarial fever of cattle. This disease, owing to the thorough knowledge of it which has been developed by our investigations, no longer has terror for our stockmen. The thorough control now exercised over cattle shipments from the infected area is an almost complete protection, but it must be kept in constant operation to be successful. Nearly 1,500,000 inspections were made

in this service, and 45,400 cars were disinfected. It is hoped through intelligent effort to considerably reduce the area now infected with this contagion.

Much attention has also been given to the repression of scabies in sheep. The number of animals inspected in this service was nearly 8,000,000, and over 1,000,000 were dipped in a proper liquid for the cure or prevention of the disease under the supervision of our inspectors. The effect of the regulations bearing upon this disease has been remarkably beneficial, the number of diseased sheep reaching the markets of the country having been greatly reduced.

One of the most common diseases of cattle is known as blackleg—a malignant and fatal swelling which appears frequently in one of the limbs, causing great discoloration of the affected parts. The only means of combating this disease is by vaccination, and to assist our stock raisers more than one and a half millions of doses of the vaccine have been distributed. This is an increase of more than 50 per cent over the previous year. The demands for this vaccine have been most urgent, and it is evident that its preparation and distribution have been of great benefit. The reports show that the losses have been reduced to less than 1 per cent in affected herds, whereas formerly they were in most cases 10 per cent or more.

Tuberculin and mallein have also been prepared and distributed to State and other local authorities to aid them in detecting tuberculosis in cattle and glanders in horses. The assistance thus rendered has enabled much work to be done locally for the control of these diseases which otherwise would not have been possible. More than 44,400 doses of tuberculin and 7,000 doses of mallein have been thus supplied.

There are several lines of work which might still be taken up with much benefit to stock raisers in certain sections of the country. Cattle for improving the blood of the herds of our Southern States can only be taken there safely after inoculation with the germs of Texas fever. The Missouri Agricultural Experiment Station has had the enterprise to undertake the inoculation of cattle which the breeders of that State desired to ship to the infected area, and the Texas station has also done good work along this line. It was first shown by this Department that such inoculation was a practicable method of prevention, and in the interest of the large section of the South which needs inoculated stock and at present can not obtain it the Bureau of Animal Industry should undertake to thus treat animals which are intended for interstate shipment. There has also been witnessed a considerable outbreak of anthrax in the southern Mississippi Valley, and the Department has been unable to give aid, notwithstanding most urgent appeals. This disease may likewise be prevented by a reliable vaccine, but the facilities and appropriations now available will not permit this work to be undertaken.

PATHOLOGICAL INVESTIGATIONS.

Investigations of numerous diseases have been in progress. Much work has been done with a view to the discovery of some more effectual method of controlling hog cholera than has yet been devised. Tuberculosis has been investigated to learn more about the proportion of affected animals which produce infected milk, and to determine whether bovine tuberculosis is communicable to man. Other interesting and important diseases of horses, cattle, sheep, and poultry have been investigated in order to assist the inspection service in its work or to grant relief in outbreaks to which the attention of the Department has been called. In the treatment and cure of parasitic diseases of sheep and of an eruptive skin disease seriously affecting the heads of these animals, valuable discoveries have been made, which are immediately available for the relief of the sheep industry. Other discoveries as to the nature of several diseases have been made which can not be described at this time.

STATE RESTRICTIONS ON THE INTERSTATE LIVE-STOCK TRAFFIC.

Inspection laws and regulations are enforced in a few States, which duplicate the inspection made by the Bureau of Animal Industry of animals which are shipped from one State to another. In addition to the inspection, some of the States demand inspection fees which constitute a serious burden on this branch of interstate commerce. This inspection and tax is not confined to cattle which are certified by the Federal inspectors and which are destined for the State making the inspection, but in some cases has been applied to animals simply shipped across the territory of a State and destined for some other section of the country. The enforcement of such a policy is contrary to the interests of the country as a whole, and is a reversion to the system of taxing interstate traffic, which became so vexatious in the period before the adoption of our Constitution. If generally sanctioned by the States it would prevent the marketing of live stock from some sections; it would absolutely prohibit shipments across the country, as from Massachusetts to California, and it would destroy much of the usefulness of the Federal inspection and certification, which has become of such value and which has been established by Congress to insure fair treatment and facility of shipment to all sections of the country. So menacing is the present situation to the great cattle industry of the Southwest and West that I have requested the Attorney-General of the United States to cooperate in bringing the matter promptly before the Supreme Court for decision as to the constitutionality of these State laws. It is a matter for congratulation that this request has been favorably received and that the assistance of the Department of Justice is promised, with a view to obtaining an early adjustment of this serious question.

BUREAU OF PLANT INDUSTRY.

The Bureau of Plant Industry was one of four Bureaus organized during the year in accordance with an act of the last Congress. The advantages of bringing together the allied lines of work in the Department were pointed out in my last report, and already good results have been secured by following the policy there laid down. Congress authorized the bringing together of the plant physiological and pathological investigations, the botanical investigations, the grass and forage plant investigations, the work on pomology, and the experimental gardens and grounds; and during the year the Arlington experimental farm, the investigations in the production of domestic tea, the work on foreign seed and plant introduction, and the Congressional seed distribution have been added by executive order, making nine branches in all. The unification of work and the advantages resulting from close cooperation and perfect elasticity to all branches composing the Bureau as at present organized prompt me to urge that Congress take proper action toward broadening all lines, as provided for in the estimates for the next fiscal year. As at present constituted the Bureau has a corps of more than 200 efficient workers, and nowhere else in the world are so many important plant problems being studied. The past year has been marked by important advances along many lines, a few of which may be noted here.

PLANT PHYSIOLOGY AND PATHOLOGY.

The field of plant physiology and pathology is an exceedingly broad one, involving, as it does, a study of normal plant life on the one hand, and abnormal conditions on the other. Although this work is comparatively new, its advances have been rapid, especially during the past three or four years, largely as a result of the work done by the Department. The great aim of all this work is to make it reach the farmer, and to do this it is essential that the practical features should always be kept in mind. Following are some of the practical results obtained in the past year, showing the bearing of this work:

WORK ON COTTON DISEASES.

Cotton is subject to many serious diseases, some of which cause immense annual losses. These losses are not evenly divided, but fall with crushing effect upon individual growers and communities. In the sea-island region, where the fine grades of sea-island cotton are produced, hundreds of acres, including many fine farms, have been rendered worthless for cotton by a disease known as wilt. This is due to a fungus parasite in the soil, which for several years has been spreading slowly but surely throughout the cotton areas of the Southeast. Every attempt to kill this fungus in the old way, by treating

the soil and plants with fungicides, failed, hence attention was turned to the problem of obtaining a form of cotton which, through its own inherent vitality, would be able to resist the disease. The clew to this had already been noted in the fact that individual stalks here and there in a field of cotton would resist the attack, and this suggested the plan of selecting seed from such resistant stalks, thus gradually securing a form which would be immune. This has been accomplished, and it is planned to extend the planting of the resistant sorts as rapidly as the work can be pushed.

In this connection, another interesting and valuable discovery has been made in the matter of securing also a resistant cowpea. The cowpea is used in rotation with cotton, and it was also attacked and killed by the same fungus which destroyed the cotton roots. The securing of a resistant cowpea will make it possible for the growers of the fine sea-island cotton to bring back their land to its once high value.

DISEASES OF ORCHARD FRUITS.

The peach in this country has generally been a very profitable crop, but for many years it has been subject to a number of serious diseases. Some of these can now be controlled, notably "yellows" and peach-leaf curl, two of the worst enemies of peach growers. A few years ago a new disease appeared in some of the finest peach orchards of New York, Michigan, and other States, and this trouble has caused growers a great deal of uneasiness. The Department has had one of its most competent experts engaged on the disease, and he believes that he has discovered the cause. The disease in question is known as "little peach," from the fact that the fruit ripens when very small, this symptom becoming more pronounced each year until the tree dies, which it invariably does at the end of two or three years. The cause of "little peach" is believed to be a fungus which attacks the very young roots, and already the matter of preventing it by securing resistant stocks has been taken up.

DISEASES OF FOREST AND CONSTRUCTION TIMBER.

The losses due to the rotting of forest timber and timber used for construction material, such as railroad ties, bridge sills, etc., have been great, and an increasing demand has been made for information that would lead to more light as to the best methods of preventing such losses. During the year a thorough investigation of this subject was inaugurated, the work being undertaken in cooperation with the Bureau of Forestry. An expert was sent to Europe to secure information as to the methods employed in controlling timber rots there, and extensive experiments were inaugurated to determine the best methods of preserving construction material and the prevention of diseases in standing timber.

PLANT-BREEDING WORK.

The breeding of plants for the purpose of obtaining forms resistant to disease and better adapted to the new and changed conditions which are constantly arising is rapidly becoming an essential feature in agriculture. Attention has already been called to the work of securing strains of cotton resistant to wilt and other diseases. The remarkable success of these experiments indicates the importance of this phase of plant-breeding work. Some new strains of upland cotton were also secured by hybridizing the short and long staple cottons. One of these hybrids in particular is said by experts to be superior to any upland cotton now grown. Numerous other valuable hybrids and select strains have been developed, and these are being tested and their characteristics fixed. A hybrid between one of our American upland cottons and an Egyptian variety promises to be greatly superior to either parent.

For several years the Department has been working to secure, by breeding, a race of oranges resistant to frost. It was proposed by this means to restore the orange groves of Florida, which formerly produced several million dollars' worth of oranges yearly, but were nearly all destroyed by cold a few years ago. Twelve of the new evergreen hybrid oranges, secured as a result of crossing the hardy Japanese form with the Florida sweet orange, have proved to be the hardiest evergreen oranges known in the world. Southern nurserymen have pronounced them to be of great value as hedge plants, entirely apart from their fruit-bearing value. There is great promise, however, that we will ultimately secure a fruit that is hardy and of good quality. Some of the hybrid raisin grapes, produced with a view of securing resistance to a disease known as "coulure," or dropping of the fruit, have borne for the first time. These vines have proved hardy so far and have produced fruit of remarkably fine quality. Some of the vines appear to be resistant to a serious and destructive root disease which has appeared in California, and they may resist the worst of all Pacific coast grape diseases—the so-called "California vine disease."

A serious problem which for many years has confronted the farmers of the West is the securing of plants resistant to the alkali soils of that region. Wherever agricultural crops are being grown there has been more or less adaptability of plants to the peculiar conditions existing in many parts of our Western country, and as a result some plants are found to give much better yields on certain soils than others, mainly through their ability to resist the large amount of alkali present. In connection with the breeding work important investigations have been inaugurated looking to the development of resistant plants of many kinds, special attention being given to the forage crops, as these are of great importance. In this connection cooperation has been secured with the Bureau of Soils, whose work during

the past few years in the West has brought about a much better understanding of some of the important questions concerning the agricultural development of that region. Other important lines of work in the matter of plant breeding have to do with cereal improvement, but these will be more fully discussed under "Introduction of seeds and plants."

NITROGEN-GATHERING BACTERIA.

Nitrogen is one of the most costly and probably the most important of all plant foods. So valuable is this material and such is the demand for it that already it has been predicted that it is only a question of a few years until the commercial supply will be exhausted. Recently, however, attention has been turned to the bacteria which develop nitrogen in connection with the roots of clover, beans, and many related crops. A new method of cultivating and obtaining these organisms in large quantities for distribution with leguminous seeds has been discovered, and will be perfected and put into practical use during the coming year. This, it is believed, will make it practicable to grow many leguminous crops where, owing to the lack of proper organisms, they have refused to grow in the past. It will also make practicable the use of a large number of legumes for gathering nitrogen.

BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

The botanical investigations and experiments conducted by the Department have led to many valuable discoveries, and from year to year their great practical value is being recognized more and more. The work being done on seeds, improvement of crops and methods of crop production in our tropical possessions, and prevention of the great losses of cattle in the West through the eating of poisonous plants is of special interest. The following are some of the more striking results of the work done under this head during the past year:

NEW FACTS CONCERNING KENTUCKY BLUE-GRASS SEED.

The Department of Agriculture has for a number of years past purchased considerable quantities of Kentucky blue-grass seed for Congressional distribution. Since the practice was inaugurated of making germination tests of all the seeds distributed it has been found that Kentucky blue-grass seed, as offered in the open market, could not be secured ordinarily of a higher germination than 50 to 60 per cent. On the other hand, it was found possible, by special purchase, to secure seed showing a germination of 90 per cent and more. These facts suggested an investigation of the causes of the low germination of ordinary commercial samples. It has been found that in harvesting this seed the tops of the grass are stripped from the growing plants

when green and piled in windrows. In this stage, unless great care is taken in turning and airing the mass, a heating takes place in which the temperature rises sometimes as high as 173° F. The tendency of this heating is to destroy the germination of the seed. This fact is readily applied, even under the methods of handling the grass seed which are now followed in the areas where it is grown. In order, however, to secure the most practical results, the Department is now engaged in experimenting with machinery which will dry the moist seed without permitting it to heat, and at the same time without destroying its germination in any other way. There is good prospect that suitable machinery will be found.

SECURING A STAND OF BERMUDA GRASS FROM SEED.

One of the most valuable pasture grasses for use in the Southern States is Bermuda grass, a species of tropical origin. In our latitude this grass seeds very sparingly, and the method of securing a field of it has been to transplant roots. This method, however, is so expensive as to be almost prohibitory. Experiments have been made with good imported seed by the Department during the past two years on the trial grounds at Washington, and it has been found that when sown at the rate of 3 pounds per acre during a portion of the year in which the ground continued moist, a good stand from 3 to 6 inches high was secured in forty-five days. The procuring of good germinable seed and the adaptation of the above facts to conditions in the South should make it possible to secure at a moderate price an excellent stand of this valuable grass.

SUPERIORITY OF AMERICAN-GROWN CLOVER SEED.

Owing to a controversy in Europe regarding the relative value of American and European clover seed, the Department has undertaken some comparative experiments, the initial series of which was conducted at Washington. Many samples of clover seed of known origin from the different countries of Europe and from different parts of the United States and Canada were grown under like conditions. Cuttings of hay were made at suitable intervals, the product of each plot being carefully weighed. These experiments, which have now been under way for two years, show conclusively that under the conditions existing here the European red clover is decidedly inferior in productiveness to the American. Apparently the American strain is better adapted to the conditions of bright sunshine, periodic heat, and dryness that exist here. For the purposes of our farmers, therefore, a decision of the question whether to use American or imported seed is easily reached. During the past year a series of supplementary experiments has been started at typical selected areas in different parts of the United States, to see whether these results hold in the principal clover-growing States.

A REMEDY FOR STOCK POISONING.

The loss of stock in Montana, caused by poisonous plants, has been estimated at from fifty to one hundred thousand dollars per annum. Prior to the present fiscal year there was no simple and reliable way of saving stock when poisoned, but now, by a series of careful experiments conducted at the request of the Montana authorities, the Department has shown that if a small tablet consisting of permanganate of potash and sulphate of aluminum be promptly administered the greater part of this loss can be averted. The action of the permanganate is to oxidize and destroy the poison still remaining unabsorbed in the stomach, and this action is intensified by the sulphate of aluminum. The poisonous plants that respond to this treatment are, so far as ascertained, larkspur and poison canas, the two plants that cause most of the losses in Montana.

STUDIES OF AMERICAN FIBER PLANTS.

The Department's work with Egyptian cotton, outlined in my previous report, has produced very encouraging results, and it is now believed that it can be successfully grown in this country. As early as 1892 the Department imported and distributed seed of some of the choice Egyptian sorts, but owing to lack of money the matter was not followed up. Recently, however, considerable seed has been imported, and the outlook for the growth of this cotton is much more encouraging. Additional facts in regard to what has been accomplished in this line will be given under "Introduction of seeds and plants from foreign countries." Some very encouraging results have also been obtained through our studies of hemp, especially in regard to imported kinds, and particularly those from Japan.

TROPICAL AGRICULTURE.

The acquisition of tropical territory by the United States has made it important and necessary that the Department become thoroughly familiar with the agricultural conditions prevailing in these lands, and their possibilities in crop production, (1) for the purpose of supporting the present population; (2) for supporting the population which will result from the new and changed conditions, and (3) for bringing in revenue from outside sources. The United States pays out millions of dollars annually for tropical products which we ought to grow, and which we can grow without interfering in any way with well-established industries. Coffee, rubber, bananas, cacao, and many other tropical crops not hitherto grown by us can now be produced, and attention has been turned to the best methods of succeeding with such crops.

It is evident that for many years the Department will have to keep in close touch with whatever work may be inaugurated in these outly-

ing lands; hence, experiment stations established there must be so organized as to be an integral part of the Department. In order to do this the stations should be put in charge of men from the Department who are familiar with existing conditions and whose knowledge will render them strong supporters of the Department's work. This policy has already been carried out in the case of the stations established in Hawaii and Porto Rico. The tropical work proper of the Department, therefore, will be along the lines already laid down, and wherever practicable will be carried on in cooperation with the stations established, whose energies, for a number of years at least, must be devoted to matters more or less local.

The improvements in the coffee industry of Porto Rico are an example of what has already been accomplished in this direction. Among the agricultural imports of the United States, coffee is second only to sugar, our annual importations averaging \$70,000,000, and only a small fraction of 1 per cent of this quantity comes from our tropical islands. The most important industry of Porto Rico, however, is the raising of coffee for European markets; hence, it has received early attention in our investigations of tropical agriculture. It has been found that the Porto Rican coffee plantations are seriously injured by being too heavily shaded, and also that shade is not, as commonly believed, a necessity, the supposed good effects resulting from it consisting simply in the fixation of nitrogen in the soil by the root tubercles of the leguminous trees used for shade. The other advantages of shade are only indirect, consisting in the protection of the soil from heat, drought, and erosion. Rational moderation in the use of shade, the raising of seedlings in nurseries, and other practical cultural improvements would double or treble the island's output of coffee, and with the increase of acreage readily possible for this crop the island could be made to produce more than half of the coffee consumed in the United States. The work now under way is planned to bring this about, and encouraging results have already been obtained.

GRASS AND FORAGE PLANT INVESTIGATIONS.

The problems involved in the investigations of grass and forage crops are some of the most important that to-day confront the American farmer. As population increases and competition in all lines of agricultural work becomes keener, the need becomes strongly felt for more light on such important questions as: How to restore the great ranges of the West; how to maintain our pastures; how to meet the trying conditions in the South and semiarid West in supplying food for stock, etc. The work of the Agrostologist is conducted with a view to solving these problems, and already very encouraging and promising results have been obtained, some of which may be referred to here.

RANGE IMPROVEMENT.

The loss to the cattle interests of the West during the past fifteen or twenty years, as a result of injudicious management of ranges, has been heavy. In order to obtain some information as to the possibility of restoring these overstocked lands, experiments in regrassing were undertaken at Tucson, Ariz., in cooperation with the agricultural experiment station, and at Abilene, Tex., with Mr. H. L. Bentley, employed by the Department for this work and living at that place. At Tucson a small area of land was secured for the experiments, the ground having been previously denuded of grass through overstocking and mismanagement. Very promising results have already been obtained in connection with this work, it having been shown that by comparatively simple and inexpensive methods much can be done toward bringing the ranges back to their original condition. The experiments at Abilene, a report on which has been prepared, have demonstrated conclusively the possibility of greatly improving the cattle ranges by practical methods and at comparatively little cost, the stock-carrying capacity of the range lands selected for the experiments being doubled in three years. Mr. Bentley claims that it is not only possible to restore the worn-out and grass-denuded ranges to their former productiveness, but that while this is being done cattle may be pastured on them and the number increased from year to year as the capacity of the pastures to sustain them is increased.

Widespread interest in this work has been aroused, and so great has been the demand for its extension that an estimate for additional appropriations to carry on the investigations has been made. I earnestly recommend that the increase asked for be granted, and, furthermore, that action be taken by Congress giving you, Mr. President, authority to secure for the experimental needs of this Department such tracts of public range lands as may be necessary for the best interests of the work.

GRASS GARDENS.

Nothing is more instructive to visitors than to see grasses and forage plants growing, and for this reason considerable time has been devoted to developing the gardens at Washington, and at Buffalo in connection with the Pan-American Exposition. In these gardens the cultivation of ornamental grasses and of grasses suitable to lawns was specially undertaken for the information and guidance of those interested in beautifying the home. More than 300 varieties of grasses and forage plants have been brought together in the gardens at Washington, and many interesting and valuable results have been obtained through a study of their behavior under the conditions of climate and soil prevailing here. A feature of the Pan-American Exposition was the Department's exhibit of growing grasses and forage plants. This exhibit was located near the Government building and attracted wide-

spread interest and attention from the first. As the season advanced and the characteristics of the different grasses became manifest, dairy-men and farmers from all sections of the country visited the plots and were much interested in the object lessons they taught.

A unique feature of this exhibit was a display of the sand-binding grasses, the object of this being to illustrate how vast tracts of land along our seacoast may be made profitable at comparatively small expense. A miniature sand dune was produced artificially, and on it were planted the common beach grass of the Atlantic coast north of Virginia, sand millet of the coast of Virginia southward, the sea lyme grass from the coast of Oregon, long-leaved sand grass from the lake shores, and other sand-binding types. Naturally these grasses are never found except in drifting sands, for the fixing of which they are well adapted. Altogether this work has done much to show in an instructive way many interesting features of the grass and forage plant investigations.

COOPERATIVE WORK WITH EXPERIMENT STATIONS.

Another important feature of the work of the Agrostologist during the year was the formulation of a plan for conducting experiments with grasses and forage plants in cooperation with the experiment stations. Formal articles of agreement, setting forth the objects of the experiments, the respective features of the work to be assumed by each party to the agreement, and the manner in which the results obtained may be used by each, were drawn up and the agreement signed by the proper officials of the Department and the stations. In some cases the Department assumed a part of the expenses connected with the experiments, while in others it simply furnished the necessary seed and expert services in preparing the plans.

In arranging for the work care was exercised in each case to select a station in the locality where the solution of the particular problem to be taken up seemed most important, and where the best facilities were provided. The plans have met with general approval, and already cooperative experiments are being conducted with 13 stations. The problems taken up have widespread application, and the results so far obtained lead to the belief that great good is to come from the work as a whole.

POMOLOGICAL INVESTIGATIONS.

The fruit interests of this country have grown to enormous proportions, and the pomological work of the Department is designed to promote them in every way possible. With this end in view, a large exhibit was last year maintained at the Paris Exposition, the object being chiefly to encourage a demand for American products. The beneficial effects of this work are already showing in the increased demand for American fruits, especially oranges and apples. In 1899

the United States exported 380,222 barrels of apples, valued at \$1,210,459. In 1900 526,636 barrels were exported, valued at \$1,446,555. Already in 1901 855,673 barrels have been exported, valued at \$2,058,964. The value of the oranges exported in 1901 is double that of 1900, all of which can largely be traced to the interest aroused by the work at Paris.

EXTENSION OF FRUIT MARKETS.

In order to open up additional markets for our fruit and to bring about better methods of harvesting, packing, storing, and shipping the same, a small fund was secured for the present fiscal year, and the results accomplished with this encourage the belief that there are great possibilities for trade in American fruit abroad. Trial shipments of pears, peaches, and other fruits have been inaugurated with such encouraging results that it is believed the work will be undertaken next year on a commercial scale by private interests. With the unrivaled facilities America possesses for growing the finest fruits, and with a clear understanding as to the proper methods of handling, there is no reason why a fine foreign trade should not be developed.

ENCOURAGING THE PRUNE INDUSTRY OF THE PACIFIC COAST.

The prune industry of the Western States has grown to large proportions, but in order to compete with foreign trade the need has long been felt for a better knowledge of methods of growing and handling the crop and the best varieties to plant. By an arrangement between the Pomologist and the Botanist an agent was sent during the year to France to study the prune industry there. The work of this agent resulted in the discovery and introduction of several important varieties that promise to be of value in the Pacific Northwest.

GROWING EUROPEAN GRAPES IN THE SOUTH.

The United States imports every year large quantities of European grapes, which are sold mostly for table use. It was believed that some of these varieties could be grown in the South, and to test the matter a number of plantings were made there three years ago. These grapes fruited one year ago, and the indications are that some of the varieties will be found valuable for our markets.

EXPERIMENTAL GARDENS AND GROUNDS.

Under the new arrangement through which the experimental gardens and grounds become a part of the Bureau of Plant Industry, plans have been made for using them in connection with nearly all lines of work. The greenhouses and conservatories prove valuable for the propagation of many useful plants secured by the agricultural explorers and others. Much has been done during the year toward

increasing the valuable collections already on the grounds and propagating and disseminating to nearly all parts of the country rare forms which have proved valuable. A part of the force of the gardens has been employed in gathering seeds of rare trees and other plants, and from them growing seedlings for distribution. The cultivation of plants under glass is rapidly assuming important proportions, many millions of dollars being annually invested in this work. There has long been felt the need of careful experiments to determine methods of growing such crops and improving them. To this phase of work special attention has been devoted, and already promising results have been obtained.

THE ARLINGTON FARM.

This farm, which was placed at the disposal of the Department two years ago, consists of about 400 acres of rolling land, and, as a whole, is very well suited for the purposes set forth in the act. The appropriation available has been devoted to getting the ground into shape, and already marked improvements can be noted. A large part of the preliminary rough work, such as clearing, draining, etc., has been accomplished, and the general plan of getting the land into condition for planting, preparatory to inaugurating experiments, has been perfected. The farm can be made a valuable adjunct of the Department, and will be so managed as to give opportunity for conducting practical experiments in many lines of work. The shaping of a general plan with this object in view is necessarily slow, as each step must be carefully considered. Buildings will soon be needed, and recommendations have been made to this end.

PRODUCTION OF TEA IN THE UNITED STATES.

The production of several kinds of tea in the United States is now an assured fact, and in addition to this it is encouraging to be able to announce that experts who have examined the tea produced here this year pronounce it equal in flavor and aroma to the best imported teas. As pointed out in my previous report, the profit in this crop averages from \$30 to \$40 per acre net. During the year Dr. Charles U. Shepard, of Summerville, S. C., has been in charge of the Government work, conducting it in connection with his large tea gardens at the place mentioned. This year Dr. Shepard produced about 4,500 pounds of high-grade tea, for all of which a ready market was found in the North. During the year Dr. Shepard perfected a machine for the manufacture of green tea, and has very generously placed this under the control of the Department, so that those wishing to use it may do so without paying royalty.

Capital is always timid of investments in new enterprises of this kind, and there is still much to be done to demonstrate the possibil

ities of the work in other parts of the South. The labor problem is an important one, but Dr. Shepard has shown his ability to handle it, and with his aid the Department is now training a few young men in the technique of the work. The extension of the industry in the South and studies for the purpose of improving the quality of tea will be pushed as rapidly as the moneys at hand will permit. There are thousands of acres of land and thousands of idle hands that might be made available for this work, and our possibilities in this field should not be neglected. The United States imports from \$10,000,000 to \$12,000,000 worth of tea every year, and, although it may be a long time before anything like that amount can be produced in this country, the industry should be encouraged in every possible way.

INTRODUCTION OF SEEDS AND PLANTS FROM FOREIGN COUNTRIES.

The act of Congress establishing the Department of Agriculture specifically provides for the introduction and dissemination of rare and valuable seeds. More or less of this work has been carried on for forty years, but recognizing the needs for enlarged and systematic efforts along this line, steps were taken three years ago which led to a great increase in the Department's opportunities in this direction. Briefly stated, the object of this work is to encourage the building up of home industries and thus save the American people large amounts annually sent abroad. With our vast resources and variety of climate and soil, and a people who are never daunted by the difficulty of an undertaking, the possibilities of developing new fields seem unlimited. In probably no branch of the Department's work can the practical value of its efforts be more quickly shown than in this line. Some of the results achieved the past year are set forth below, and a study of these will show in what manner new industries may be developed.

DEVELOPMENT OF THE RICE INDUSTRY.

In my last report attention was called to the fact that the introduction of Japanese rice resulted in an increased production, amounting to at least \$1,000,000, of this commodity in Louisiana, and furthermore, that the impetus given to the work in Louisiana and Texas led to the investment of not less than \$20,000,000 in the industry. In 1900 about 8,000,000 pounds more rice were produced than in 1899, and this year 65,000,000 pounds more were produced than in 1900. With the rapid increase in our own production the importation of rice from foreign countries is falling off, as shown by the fact that in three years the imports have decreased from 154,000,000 pounds to 73,000,000 pounds. All the increase in home production can not, of course, be ascribed to the Department's introduction and distribution of Japanese rice, but the great impetus to its production in this country was

given by the Department's introduction three years ago. Evidently it will be but a few years until the United States will not only grow all the rice consumed here, but will export part of the product as well.

MACARONI WHEATS.

The United States imports over 16,000,000 pounds, nearly \$800,000 worth, of macaroni annually. This product is made from a special class of wheats, which, until recently, had never been given a thorough trial in this country. The Department secured a quantity of the wheats, and it has been found that they are well adapted to a wide extent of territory in the West and Northwest. During the last two years they yielded one-third to one-half more per acre than any other wheats grown side by side with them, and in 1900, when other wheats were almost a complete failure in the Dakotas, the macaroni varieties produced a very good yield, and the grain was of excellent quality. They have also been very successfully grown in Kansas and Nebraska. The results of last season's work show also that a high quality of grain of this class can be produced.

The Department has made every effort to bring the producers and buyers of this class of wheat together, with the result that the demand for it now more than equals the supply. Moreover, certain companies are now for the first time offering for macaroni wheats, which include the well-known Wild Goose that was heretofore invariably rejected in the markets, about the same price as is paid for No. 2 Northern. There is a demand for carload lots of macaroni wheat for seed as well as for milling. Our own factories for making macaroni are awakening to the importance of using these special wheats instead of the ordinary bread wheats, and the demand for macaroni flour for this purpose is already greatly in excess of the supply. Besides the home demand for these wheats there is a good market abroad.

The building up of the macaroni industry, which has been carried on as a part of the pathological and physiological investigations, shows the importance of concentration of effort on a single crop. With the factories ready to take the wheat and to make from it macaroni equal to the foreign article, it will not be long before the \$800,000 sent abroad can be kept at home.

NEW FORAGE CROPS.

For many years there has been an urgent demand for some good grasses and forage plants for the States of the Great Plains, especially for the Northern States, where the winters are so cold and dry that ordinary forage plants are killed out. This demand has been met to a great extent by the importation of the smooth brome grass (*Bromus inermis*), as stated in last year's report. This grass comes from

Russia and Hungary, and has proved to be most excellent for pasture and hay, being perfectly hardy as far north as North Dakota. A hardy alfalfa imported from Turkestan has also proved valuable, being far more resistant to cold and drought than those ordinarily grown and which came originally from much less rigorous climates.

HOPS AND BARLEY.

Although hops have been grown in this country for a great many years, they have always been inferior as compared with the best European hops, and as they bring a lower price in the market and are not so desirable as the Bavarian hops, cuttings of the best of the latter were imported last year. These cuttings have been placed in the hop-growing districts of the United States, and promise to be far superior to the ordinary varieties grown, in addition to maturing earlier and extending the picking season.

American barleys are also inferior to the Bavarian barleys, being too nitrogenous and not sufficiently starchy. The ordinary varieties grown in America are the six-rowed and the four-rowed kinds. The two-rowed kinds of Europe are superior for some uses. The Department therefore imported last year for experimental purposes, in addition to the hops, a quantity of the best Bavarian barleys, and these are now being tried in this country. It is hoped that by growing this improved barley, as well as the superior varieties of hops, the importation of large quantities of some articles of commerce will be done away with.

AMERICAN-GROWN EGYPTIAN COTTON.

Approximately \$8,000,000 worth of Egyptian cotton is imported into this country every year, there being a special demand for this cotton on account of its high quality. The Department imported some seed of this cotton several years ago, but more recently larger quantities were obtained and placed where the variety seems likely to succeed. Very encouraging results have been obtained from the work, and this year a bale of Egyptian cotton, grown from imported seed in southern Georgia, was given a thorough spinning test in a mill in Connecticut, and was pronounced equal to the best imported grades. It is believed that we can grow this crop, but aside from this the cottons themselves will be valuable in breeding forms, which in all probability will prove better than their parents.

AMERICAN DATES.

Another importation which will probably in time prove of great value to the southwestern part of the country is that of date palms obtained in Africa. A number of years ago a limited importation of these palms was made from Egypt, and, while most of them were lost through adversity of climate, the shipment helped to show the possi-

bilities of date growing in Arizona and southern California. Through agents of the Department a small shipment of date palms was secured from Algeria in 1899, and a large shipment from the same country, mostly from the borders of the Sahara Desert, in 1900, and fully 90 per cent of these are growing vigorously. This year a collection of the choicest varieties in Egypt has been obtained and sent to the Southwest, this importation being in continuation of the plan to obtain from every part of the world where the date palm is grown a complete collection of the choice varieties.

The date palm is of special value in the hot Southwestern country, since it thrives and fruits best where the summers are long and hot, as in Arizona and California. The establishment of the industry in this section, therefore, would make it possible to utilize much of the land there which, though irrigable, is too alkaline for ordinary crops. It is hoped, now that a large number of plants of the choicest varieties have been imported, that in time this country may produce enough dates to supply the home demand and, perhaps, even some for export.

CONGRESSIONAL SEED DISTRIBUTION.

Congress has assigned to this Department the duty of purchasing and distributing seeds and plants, and in order that there may be no question as to how and when this shall be done, the law in regard to it is made very specific. I have endeavored to meet the wishes of Congress in this matter in every way possible, and to the best of my ability have secured seeds of as high character as could be obtained under the conditions under which we work. Notwithstanding all precautions, however, the system of securing seeds through a contractor is apt to cause trouble, not so much on account of the likelihood of having inferior seed furnished, as of the contractor's inability to furnish the varieties called for, owing to the quantity required. This was especially the case the past year, and so many complaints were received in regard to this and other points pertaining to the work that I ordered a thorough investigation by the Chief of the Bureau of Plant Industry, in whose charge the entire matter has been placed. No settlement has as yet been made with the contractor for last year's seed, and none will be made until every requirement of the contract has been fulfilled. No matter what the issue, the Department is fully protected on every point.

Although the amount to be expended for seed for the forthcoming distribution is double what it was last year, the work has been so systematized that no apprehension is felt as to our ability to send out all seeds on time. As soon as it was known how much would be available for the work, immediate steps were taken to get all the preliminaries arranged, and as a result the schedule, which provides that the distribution shall begin December 1 and end March 1, will be carried out to the letter.

In the distribution of the vegetable seed through a contractor three important essentials are provided for; that is, (1) the seeds must be true to name; (2) they must have a high vitality, and (3) they must be free from mechanical impurities. The scientific staff of the Bureau of Plant Industry is charged with the important duty of seeing that these conditions are complied with, and for every failure the contractor must abide the consequences.

In order to increase the value of the work, several changes have been made, which may be briefly referred to here. It has been arranged to send out the cotton seed, tobacco seed, sorghum seed, and sugar-beet seed, and the grasses and forage plants under the direct auspices of the officers of the Department and not through a contractor. By following this plan we have been able to adopt a number of innovations which it is believed will add greatly to the value of the work. The cotton seed, for example, will be selected from high-yielding and comparatively new sorts. The Department has been working for several years improving cottons by breeding and selection, and gradually the seed of these new forms will be worked into the distribution. Furthermore, the adaptation of certain varieties to peculiar conditions of soil and climate will be considered, and this, together with the gradual extension of better grades, will, it is believed, do much to improve the cotton industry in the South. Tobacco seed will be handled in very much the same way as the cotton seed, selected seed being used and varieties sent into districts where the conditions of soil and climate are favorable for their highest development.

With the grasses and forage plants the object will be to demonstrate what varieties are of special promise for different regions, and to this end the country will be properly districted and such seed sent into each district as the experience gained through the work of the scientific branches of the Department may suggest.

It has long been my belief that much good might be accomplished by using a part of the appropriation in a judicious dissemination of some of the more valuable trees. Plans have therefore been made to place at the disposal of each Senator, Member, and Delegate in Congress a limited number of selected trees, the object being to encourage a love for tree planting and all that this work involves. It will, of course, be entirely beyond the scope of the Department to send a large number of trees to any one place, but it is believed that the action contemplated will eventually lead to extensive planting through the educational effects of the work. Commercial establishments are well prepared to supply trees in nearly all parts of the country at reasonable cost, and the plan of our work will, it is believed, eventually advance their interests. Already there has been secured for distribution a choice collection of nut trees, principally pecans, and these are

being grown by the Department from nuts gathered from selected trees in all parts of the country.

It is believed that some such plan as outlined for the distribution of the special crops mentioned above can be applied also to the general distribution of vegetable and flower seeds. It will certainly be an advantage to intelligently district the country and send into each district only such seeds as are likely to improve its conditions. This will obviate the necessity of having to secure such immense quantities of single varieties, a task which is often difficult to perform. It will furthermore enable the Department to gradually introduce into the distribution rarer sorts, and to drop these after the first year or two, leaving the demand for them to be supplied by the trade. When the Department has secured the seeds and plants which it is believed are best adapted to certain districts, its responsibility, to a certain extent, ends, as it looks to Senators and Members of Congress to place them in the hands of such of their constituents as in their judgment will make the best use of them. Due notice, however, will always be given of every special distribution, and in addition all information that the Department possesses will be furnished, so that the recipients may act intelligently in handling whatever may be sent out. Carrying out the work as here outlined it is believed will result in good to the entire country, as is the intent of the existing law.

BUREAU OF SOILS.

The Division of Soils was organized in the Weather Bureau in 1894 by Executive order. In 1895 it became an independent division in the Department, with an appropriation of \$15,000. In 1899 the functions were enlarged to include the mapping of tobacco soils and other necessary tobacco investigations, with a total appropriation of \$26,300. In 1900 the appropriation was increased to \$31,300. In the act approved March 2, 1901, the Division was reorganized into a bureau, with an appropriation of \$109,140, and in joint resolution No. 8 of the same Congress provision was made for the printing annually of 17,000 copies of the Field Operations of the (then) Division, at an estimated cost of \$20,000; 3,000 to be distributed by the Senate, 6,000 by the House, and 8,000 by the Department.

This remarkably rapid evolution of the soil work of the Department from a subordinate division of the Weather Bureau to a bureau organization of its own, within a period of six years from its inception, is based wholly upon the economic importance and value of the work, the careful and conscientious administration of its affairs, and a thorough understanding and appreciation of its aims by the people upon which the liberal support accorded by Congress has been granted.

The Bureau of Soils is charged with the study of soil problems in

their relation to practical agriculture; with the investigation of the physical and chemical properties of soils and of the materials and methods involved in artificial fertilization and its influence upon the original soils; with the classification and mapping of soils in agricultural districts to show the distribution of the various soil types, with a view to determining their adaptability to certain crops, and their management and treatment; with the investigation of alkali problems and their relations to irrigation and seepage waters, the causes of the rise and accumulation of alkali, and the reclamation of injured or abandoned lands; with the investigation of tobacco soils and the methods of cultivation and of curing, with especial reference to fermentation; the introduction, through selection and breeding, of improved varieties into the principal tobacco districts of the United States, and to secure as far as may be possible a change in the methods of supplying tobacco to foreign countries.

The reorganization of this Division into a Bureau of Soils, with a large increase of funds and a corresponding enlargement of the opportunities for work, went into effect on July 1, 1901; but \$10,000 had been made immediately available, and the gradual adoption of the plans of reorganization occupied fully six months of the fiscal year for which this report is intended. The reorganization was based upon the following facts:

In my last report I called attention to the great demand for the soil survey and mapping of soil areas throughout the country and the consequent need of a much larger appropriation. At that time the Division of Soils had made detailed maps of 3,386 square miles, or 2,160,000 acres, a part of which had been published, on a scale of 1 inch to the mile. This work had covered portions of Maryland, Connecticut, Pennsylvania, Louisiana, Utah, California, and Arizona. The Maryland work showed a variety of soils in southern Maryland and the Eastern Shore adapted to a number of special lines of agriculture, including truck farming, fruit growing, special types of tobacco, and general farming, and gave a basis for the specializing of crops and agricultural interests and improved methods of treating the soil, which give promise, if carried out, of important developments in that section. The work in Connecticut had pointed out the possibilities of growing the Sumatra tobacco and of building up a very profitable industry in the raising of this fine type of wrapper leaf. The possibility of this has since been shown in the production of a small crop of very desirable wrapper leaf last year and the growing during the present season of about 43 acres of Sumatra tobacco which promises very well, and which indicates to the tobacco men that the \$6,000,000 worth of tobacco which we annually import can be as well produced in Florida and in the Connecticut Valley, with large profits to our own growers.

Equally significant results are looked for in the introduction of Havana tobacco into the tobacco districts of Pennsylvania, Ohio, and Texas, and there was a great demand from these States to map the soils and investigate the possibilities of introducing new varieties of tobacco which would bring a higher market price and would tend to diminish the imports of the finer qualities of filler tobacco.

There was a strong demand from the fruit growers for the preparation of maps showing the distribution of the important fruit lands, particularly of the mountain areas in the Atlantic Coast States. The success of the mountain peaches in western Maryland and of the pippin and other varieties of apples in the mountains of Virginia and North Carolina, and the experience that these were successful only on certain types of soil, made it appear that a detailed soil map would be advantageous and would tend to prevent costly experiments on soils which years of experience might show unsuited to the crop.

The important commercial development of the sugar-beet industry and the large investments necessary in the establishment of sugar factories have created considerable interest and wide demand for soil-survey work in order to locate the best sugar-beet soils where climatic and other conditions were supposed to be favorable for the building up of this industry. The director of the Arizona Experiment Station reported that the sugar content in pounds per acre from five characteristic soils of that Territory ranged from 1,491 to 3,361 pounds, the intermediate yields being 1,521, 2,006, and 2,267 pounds, and declared that it was exceedingly desirable to have the soil outlined that gave the largest yields of sugar. Urgent requests on similar lines came from important sugar-beet areas of the southern and central coast regions of California and from those of New York and Michigan, as well as other States. With the training and experience of our field men the soils of these areas can be definitely outlined and their relation to the production and purity of sugar beets determined in advance of any costly investments which might prove unprofitable.

The work of the soil survey in the Western irrigated district and the investigation of the alkali problem, which has been a serious menace in certain localities, and the results of this survey, which show that the problem can be easily and economically controlled by underdrainage and improved cultural methods, have aroused a great deal of interest, and many urgent requests have been made that the work be extended to other areas.

The tobacco investigations are bringing most important results by the introduction of new varieties and better methods of handling the crop, thereby creating new and more important types for this country and improving those already grown. It was found imperatively necessary, in order to obtain the best results, to secure the very best

available experts in this country, and in order to do this much larger salaries had to be given than had formerly been allowed in the divisional organization. The wisdom of this step has been amply demonstrated in the results attained and in the efforts of foreign countries to induce our experts to leave and transfer their valuable work to other localities.

The Agricultural Committees of both Houses of Congress looked into these matters very carefully, and, after a thorough consideration of the questions involved, decided that the reorganization of the Division into a bureau was necessary to enable the Department to handle these lines of work in a manner commensurate with their commercial importance. Accordingly this change was made by Congress, and the appropriation was very largely increased and the organization was made much more efficient than it had been on the old divisional plan. Congress also provided for the immediate use of \$10,000 of the funds to allow of the plans being definitely formulated and men trained, so that on the 1st of July, 1901, the Bureau could start as a well-organized office for the efficient working out of the duties pertaining to it. This made it possible to secure the practical reorganization of the Bureau several months in advance of the actual operation of the law, and the wisdom of this has been amply demonstrated in the operations outlined in this report.

This action of Congress has opened up a new and very important era for the investigation of soils, which should be of fundamental value in the development of the agricultural interests of the country.

The following summary of the operations of the Division during the past year will show the economic aspect of the work and will be of interest to all those engaged in practical agriculture, especially those interested in intensive cultivation, and the introduction and management of new crops and industries, and in the remarkable advance recently made in agricultural industries of the country, which is the foundation of much of its commercial prosperity.

PROGRESS AND COST OF THE SOIL SURVEY.

The area surveyed and mapped during the fiscal year was 5,596 square miles, or 3,581,440 acres. The area previously reported as having been surveyed was 3,486 square miles, making a total of 9,082 square miles, or 5,812,480 acres. Field work was carried on during the year in California, Maryland, Michigan, New York, North Carolina, Ohio, Pennsylvania, Utah, Virginia, and Washington; and the preparations were all made for field work to be started in Idaho, New Jersey, Tennessee, and Texas immediately upon the agricultural bill going into effect on the 1st of July, and also for field work in Louisiana, Mississippi, Georgia, and Florida, to be started on the 1st of October, when parties working in the Northern States will be sent South.

The following table gives the area of soils surveyed and mapped in the several States in which the work has been carried on to the end of the fiscal year:

Area surveyed and mapped during fiscal year ending June 30, 1901, and the area previously reported.

State or Territory.	1901.	Previous- ly re- ported.	Total.	
			Square miles.	Acres.
	<i>Sq. miles.</i>	<i>Sq. miles.</i>		
Arizona		400	400	256,000
California	951	450	1,401	896,640
Connecticut		245	245	156,800
Idaho	(1)			
Louisiana		1,000	1,000	640,000
Maryland	1,137	625	1,762	1,127,680
Massachusetts		155	155	99,200
Michigan	125			
New Jersey	(1)			
New Mexico		100	100	64,000
New York	20			
North Carolina	1,700	100	1,800	1,152,000
Ohio	480		480	307,200
Pennsylvania	320	100	420	268,800
Tennessee	(1)			
Texas	(1)			
Utah	457	311	768	491,520
Virginia	250		250	160,000
Washington	301		301	192,640
Total	5,596	3,486	9,082	5,812,480

¹ Field work in Michigan and New York was started on June 15, but the area surveyed in this fiscal year was too small to report upon the cost of the work and they have not been included in the total. The preparation for the other States marked were all made in the fiscal year ending June 30, 1901, but the field work was actually started from the 1st to the 3d of July.

The total cost of the work in the field amounted to \$11,309, of which \$1,500 was paid by various State organizations. Including the cost of the work in the field, the preparation of reports, and transportation and supplies, the field work has cost the Department on the average \$3.26 per square mile, or about 51 cents per 100 acres. This is exclusive of the cost of publications. That the results have been of value to the communities and to the country at large has been attested in many gratifying ways. Requests for the extension of the work have come from prominent and thoughtful men in nearly all the States and Territories and from those interested in many of the large agricultural interests, such as sugar beet, tobacco, wheat, truck, rice, fruit; and especially from many areas where peculiar conditions of soil, climate, transportation, or labor make it necessary to introduce new crops or new methods for successful competition in the interests of the country.

Our trained soil experts remain from three to nine months in a district, visiting almost every foot of the area and mapping what they

find, studying the methods and conditions, meeting the people and learning of their successes and failures, and thus they can not help acquiring a fund of information relative to the soils, crops, and methods of the districts visited which should be a basis for the introduction of new crops or improved methods. The field men have at all times the cordial support and all the resources of the laboratories of the Bureau of Soils and of the other scientific divisions and bureaus of the Department.

Demands have been made on the Bureau for the extension of the soil survey to Alaska, Porto Rico, Hawaii, and more recently from the War Department for trained men for similar lines of work in the Philippine Islands. The lack of a sufficient number of trained men has prevented an extension of the work to any of these areas heretofore, but these demands should be met in as short a time as possible.

DETAILS OF THE FIELD WORK.

WESTERN DIVISION.

Results in California.—Field work was carried on during almost the entire fiscal year in California. The soil survey of 640 square miles around Fresno, mentioned in my last report, was completed during the first part of the year.

An area of about 300 square miles was surveyed around Santa Ana, extending from the foothills to the Pacific Ocean, the main part being formed by the vast delta plain of the Santa Ana River. In that portion of the region above the 70-foot contour there is little or no alkali, and the lands are well adapted to citrus fruits and nut trees. Below this elevation the lowlands are devoted either to alfalfa or natural pasturage and to important special industries of celery and truck growing. The fruit industry is hardly known in this portion of the area.

Nine different types of soil were recognized, each with distinctive agricultural values and best adapted to different kinds of crops. The soils of the high-lying portions of the area are, as a rule, well drained, and, owing to the small amount of water available for irrigation and the care which has to be exercised in the use of it, very little alkali has been found. The cementing of the canals and ditches to conserve the water gives an object lesson of the practical value of care and economy in the use of water on soils of this character in preventing the rise of alkali, which in the low-lying portion is a serious menace, but which can be controlled by underdrainage.

About 200 square miles were surveyed in the San Gabriel Valley. The problems encountered were purely soil problems, as there was no land injured by alkali or seepage waters, except a few small spots at the narrows where the San Gabriel River leaves the valley. The depth to standing water is great and the difficulties of obtaining water enough to keep the crops alive during the past dry years have been

the cause of much expense, but have undoubtedly saved the country from injury by alkali.

The most important problem which was encountered was the question of fertilizing the soils. California has no fertilizer-control law. Numerous brands of fertilizers are manufactured, each with a special object in view, and all are sold at high prices and with no guaranties but the manufacturers' analyses. The farmers are using large quantities of these fertilizers, in many cases unnecessarily, and in most cases without discretion, but in the hopes of supplying the requirements of the plant and of increasing the yield of fruit. There is great necessity for information on these points, and this information can only be gained through extensive plat experiments. The soil maps will show the best places to carry on this experimental work. Investigations in this line by some one competent to undertake such studies should be started at once, and the excessive application of fertilizers should be stopped, unless the necessity of such large applications is proved by experiment.

About 216 square miles were surveyed around Hanford. The most important problems encountered in this section are those of seepage water and alkali. All of the land is low, most of it being in the slough country, and when well drained and free from alkali is very productive. The drainage is into Tulare Lake and into the San Joaquin River by way of the sloughs which connect the Kings and San Joaquin rivers. During the winter and spring months the sloughs and streams fill with water and soak the subsoil, so that standing water is found at less than 6 feet from the surface of the ground. Everything possible is done to assist this filling of the soil with water, for the success of the following crop is supposed to depend upon the water which is thus stored in the soils. The natural drainage by the sloughs is often artificially blocked by dams during this period, and the irrigation canals continually carry water on the land. There is no question but that the crops are benefited by the water stored in this way at certain seasons, but at the same time some of the most valuable land is being ruined by the rise of alkali due to the high water table. Already large areas are left out of cultivation, and unless the present practices are changed further damage will ensue. Instead of damming the drainage systems, everything possible should be done to carry off the winter's excess of water, and, instead of depending upon subirrigation to furnish the needed water supply, the water should be applied from the top of the ground, which would tend to drive the alkali down.

In order thoroughly to reclaim the district and insure against further damage, a drainage district should be formed and outlet canals be dug for the free passage of the excess of water, and the sloughs which are now dammed should be opened. If winter irrigation is to be practiced, it should be from the surface, for subirrigation in such soils,

particularly if the level of the standing water comes to within 4 or 5 feet of the surface, involves serious danger of the rise of alkali. There are large areas of land already alkaline which could be reclaimed at a profit, and it is hoped that these investigations will make this point so clear that the people of the district can be prevailed upon to make the experiment of reclaiming small areas for demonstration.

Results in Utah.—About 310 square miles were surveyed around Ogden. This area is divided into two agricultural districts, a broad delta plain, upon which Ogden is situated, and in which the principal irrigation is carried on, and an upland portion composed of foothills and mountainous land. In addition to these, there is an area of nearly 100 square miles of recent delta, formed by the recession of the Great Salt Lake since the early surveys were made, in 1858. This land is now so full of alkali that no cultivated crops are grown upon it. Eight types of soil were recognized and mapped, each having more or less distinct differences and adapted to different agricultural interests.

The irrigation water of the district is exceptionally good and free from alkali. There is more than enough water to irrigate all the lands within the area, provided it were distributed at proper seasons of the year. Unfortunately, however, the larger part of it comes in the early spring, and there is frequently a shortage during the growing season. Plans are being considered for a large storage reservoir to equalize the distribution and to insure against seasons of drought and low water. Many of the canals run over deep, sandy soils, with no protection against seepage, and it is estimated that fully half of the water is lost in this way. This is not only an unnecessary waste of water, but is the cause of a large amount of injury by the subirrigation of large areas in which the ground water is so near the surface as to be harmful to crops. The whole area surveyed contains about 198,400 acres, of which 137,000 acres could be irrigated. There are actually about 40,000 acres under irrigation. In about 83,000 acres there is so little alkali that their use for cultivated crops would be absolutely safe. About 16,000 acres have sufficient alkali to make their cultivation at least dangerous, while there are 99,000 acres containing too much alkali for crops. Good lands in this vicinity are worth \$100 an acre, and when set with valuable fruit trees much more than this, so that the importance of this alkali problem here is apparent.

Results in Washington.—A soil survey was made of about 198,000 acres in the Yakima Valley. Frequent mention has been made by agricultural investigators of the alkali in the soils of this valley. The amount of alkali found by our parties was very small when compared with the area which has been irrigated, but the land which is damaged is near Yakima and is the most valuable land in the valley owing to its proximity to town and the ease with which it can be irrigated. Under the Sunnyside Canal, below North Yakima, practically no land has

been damaged yet, but there is alkali in the subsoil which may rise to the surface in low places. Excessive amounts of water for irrigation are constantly being used, and the subsoil is rapidly filling with seepage water. If this rise of subsoil water goes on much longer lands will suffer. Only a small percentage of the available land is irrigated at present, and it is hoped that the dangers of overirrigation may be shown so clearly that land which is now threatened may be saved.

EASTERN DIVISION.

Results in Pennsylvania.—During the fiscal year the survey of Lancaster area, 270 square miles, started during the latter part of the previous year, was completed. Lancaster County was selected for the work, as it is an important tobacco-producing section, that it might serve as a basis for the experiments on the improvement of the Pennsylvania tobacco and the introduction of the Cuban type of filler leaf. The area surveyed consists of a broad limestone valley, with sandstone and shale ridges of sedimentary rock, and, in the southern part, of the Piedmont plateau of crystalline rocks. The difference in the commercial value of the eight types of soil established is very great. The best limestone lands are worth from \$125 to \$250 an acre, while some of the other soils have merely a nominal value. The investigations, while started in the interests of the tobacco culture, indicate that new industries may be established on soils that at the present time are held in slight esteem. Important lessons are taught from the industry of the people which would be of immense practical value if applied in other localities. Active steps have already been taken to follow up this survey with an attempt to introduce a better type of tobacco on certain soils which closely resemble some of the Cuban soils.

During the spring of 1901 this work was extended into Dauphin and Lebanon counties.

Results in Ohio.—A soil survey was made of Montgomery County, comprising an area of 480 square miles. This county is the center of the Zimmer Spanish cigar-filler tobacco district, and it is intended to follow up the survey with tobacco investigations similar to those planned for Pennsylvania. The eight types of soil found in the county are derived from glacial material, which has been reworked to some extent by stream action.

Results in North Carolina.—The North Carolina department of agriculture asked the cooperation of this Department two years ago in the classification and mapping of the soils of that State, as a basis for experimentation upon the crops and methods of cultivation and fertilization best adapted to the several soils. In pursuance of this cooperation, a soil survey was made from Raleigh to Newbern, a distance of 100 miles, with an average width of about 9 miles, crossing the entire section of the coastal plains and reaching up into the soils of the crys-

talline rock areas of the Piedmont plateau. The area selected was close to the Neuse River, which has considerably altered the materials within a few miles of its channel, making such changes, in fact, that 16 distinct soil types were recognized and their agricultural values determined. It seems almost incredible that in a district so comparatively small as this, and on what has always been considered rather a uniform portion of the coastal plain, there should be so great a variation in the soil types, and that these different soils should have such markedly different values for crops.

The fact remains, however, that the differences are very great, and it was pointed out in the report that certain of the types are adapted to certain interests peculiar to that region or to similar regions of the coastal plains which have been studied elsewhere. The soils adapted to truck crops, bright tobacco, cotton, wheat, corn, and grass, and those which are not adapted to any of our present crops, are indicated on the maps and are described in the report.

In the spring of 1901 an area of 800 square miles was surveyed around Statesville, N. C., and a camp was established there for the training of some of our field men. The soils in this area are derived from granites, gneisses, and other crystalline rocks, and are similar to the soils of the Piedmont region in Virginia and Maryland. The principal crops are cotton, corn, and wheat. It was apparent during the survey that the agricultural possibilities of the two principal soil types have never been realized. There is a wide opportunity for the introduction of improved methods and of new crops and agricultural interests, and the North Carolina department of agriculture has announced that these possibilities will be fully investigated.

Results in Virginia.—The demands for the soil work in Virginia were so great and from such a number of widely different localities in the State that it was difficult to determine where the survey should be started. It was finally decided to take up an area in Bedford County, including a portion of Piedmont Virginia and of the Blue Ridge Mountains, and then to enter Prince Edward County, which is typically a dark-tobacco district. About 600 square miles will be surveyed in Bedford County. On the Piedmont portion of the area the soils are derived from disintegration of crystalline rocks, and the prevailing types are well adapted to grass and corn particularly. Considerable attention is already paid to the raising of cattle, and the heavy shipping and manufacturing tobaccos are produced to some extent. The most important results of the survey, however, are looked for in the classification of the mountain lands in the development of the apple industry. This section is already recognized as a prominent apple-growing district, but there is room for the extension of both the apple and peach industries. Soil types are being recognized and mapped which are adapted to these fruits and to their different

varieties, and it is believed that the work will be of great value to horticulturists.

Results in Maryland.—The cooperation with the Maryland geological survey and Experiment Station, looking to the development of the agricultural industries of the State, has been continued. Soil surveys of St. Mary, Calvert, Kent, and Prince George counties were completed during the fiscal year. In St. Mary and Calvert counties there are eight types of soil, which differ greatly in character and agricultural value. They are suited to different crops and agricultural conditions; but this fact has never been fully realized, and it is only by realization of this and the proper adaptation of the soils to the crops that the greatest development of the country can be brought about. There are soils there ranging in value from \$3 to \$10 an acre which are in every way equal to the soils in other localities worth ten times as much, and which are profitably worked at this valuation. In Prince George County a greater number of soil types was encountered and a greater variety of interests can be subserved. The proximity to the Washington and Baltimore markets should make it possible to introduce intensive methods, which would greatly change the agricultural conditions of the region. It is understood that the Maryland Experiment Station will actively push the further investigation of the possibilities of developments in the crop interests and of new methods adapted to different soils.

DRAINAGE INVESTIGATIONS.

Attention has frequently been called in the reports of the Division of Soils to the possibility and feasibility of reclaiming alkali lands and preventing the deterioration of lands from alkali by efficient under-drainage. This has been dwelt upon by other writers and presented in the strongest possible terms as the most rational and only safe method of solving the alkali problem. Unfortunately, on account of the conservatism of growers, these recommendations have received little or no attention, and there is no general recognition of the possibilities of controlling the problem in this way. Owners who are not at present troubled with alkali do not appreciate the necessity of protecting themselves, and it is a curious fact that just before the alkali becomes so strong as to prevent profitable cultivation the crop yields are the largest. After that the land deteriorates so rapidly that the owner is disheartened and is not inclined to invest money where ordinary means of cultivation have failed to secure profitable returns. It was necessary to make a practical demonstration of the possibilities of growing Sumatra tobacco in Connecticut to get the industry started. The recommendations of the Department in this regard were unheeded until the correctness of its predictions were thus demonstrated.

Attention has heretofore been called to the possibility of reclaiming

the alkali soils of the Yellowstone Valley and to the desirability of reclaiming the great alkali flat in the Salt Lake Valley, covering upward of 60,000 acres of redeemable land. It will be necessary, in order to secure the greatest benefit from the soil investigations, to make an actual demonstration of the practicability and efficiency of under-drainage in the reclamation of these alkali tracts.

In 1864 the Government of India published correspondence relating to the deterioration of lands from the presence of alkali, in which the following statements were made:

In the districts reported there were 59 villages in which the agricultural industries had been wholly or in large part destroyed by the rise of alkali. By the year 1850 it had made great progress and was becoming alarming. From that time until 1858 it increased yearly with frightful rapidity. The cause was attributed to the rising of the springs throughout the tract to within a very short distance of the surface of the soil. First of all is the development of the alkali; second, condition of dried swamp; third, inundation. Water in these valleys used to be about 40 fathoms (60 feet) below the surface, and in 1858 it was 2 or 3 feet. No temporary improvement can arrest the natural course of things, and notwithstanding accidental checks the work of deterioration, if left to itself, will gradually complete itself, the completion depending upon the amount of land the amount of water can affect. Attention is called to proper construction of canals and irrigating ditches, so as to prevent loss from seepage, and the necessity of economy in the use of water. With such precautions taken, underdrainage would be a sure means of reclaiming the lands from alkali and seepage waters. There is no economical substance practicable within the means of cultivators of any section capable of remedying the saline matters, but wherever drainage can be accomplished the thorough working of the surface soil, with abundance of water from the canal, will, if continued for a couple of seasons, dissolve and carry away the noxious salts, but the drainage must be efficient and rapid, otherwise the salt will merely dissolve and be again deposited in the same place. Drainage will prevent as well as cure, and even a small decimal percentage will surely and in no very long time accumulate to 3 or 4 per cent or more, according to the circumstances of the ground in relation to evaporation and drainage. Wherever alkali comes from, drainage is the only and efficient cure.

With these plain warnings from the reports of English engineers to the Government of India, it would seem that the people and the Government itself had been sufficiently well informed of the gravity of the situation and of the means for the removal of these causes. Yet in reports published by the Government of India in 1870, and even as late as 1881, it is stated that underdrainage had not been attempted, that the recommendations of the engineer officers ten or twenty years before had not been carried out, and that the alkali question was becoming more and more serious and alarming, while the Government was being called upon to support large numbers of people who had been rendered destitute by the encroachments of this evil.

In view of such marked examples as this of the ultraconservatism of agricultural communities, and the fact that the recommendations made by this Department are little heeded, I am becoming more and more convinced that, in order to carry the lessons of the soil survey home to

the individual, it will be necessary for the Department to undertake a practical demonstration of the efficiency of drainage in the reclamation of alkali lands.

Plans were made for such a demonstration during the latter part of the fiscal year, with the cooperation of the Utah Experiment Station and some of the public-spirited people of that State. It was proposed to underdrain a small tract of 10 or 20 acres and cultivate the land in a proper way for two or three years to note the improvements in condition until agricultural crops could be safely grown. The expense of underdrainage when undertaken on a considerable scale should not exceed \$15 or \$20 per acre, so that the cost of a demonstration of this kind would not be great. Unfortunately the plans were interfered with and the work has had to be temporarily abandoned. It should, however, be taken up at the earliest practicable time.

A great interest has been taken in this line of investigation in Montana, Utah, Arizona, and California, the places where the soil survey has been carried on. A great deal of interest has been expressed in this enterprise, particularly in the Yellowstone Valley, at Salt Lake City, and at Fresno, and plans are now under consideration for a demonstration of this kind at these places.

The actual field expenses of such an experiment would hardly amount to more than the cost of publication of a bulletin containing recommendations which would receive but little notice. The demonstration itself, however, if definitely carried out, would be of infinitely more value, as it would be an object lesson for the people and could not fail to arouse an interest which would spread throughout the community. While the Department is spending thousands of dollars for the investigation of these problems, the matter of expense of such demonstrations should not be considered, provided, as in this case, it seems necessary to use this means to inaugurate better methods, which will be of immense benefit to the localities.

SOIL CLIMATOLOGY.

The Division of Soils was originally organized in the Weather Bureau, under a clause "to investigate the relation of soils to climate and organic life." When for administrative purposes it was reorganized as an independent division of the Department, this work was still recognized as of paramount importance and is still authorized under the first clause of the annual appropriation bill. It was pointed out that the soil, being the receptacle of the rainfall and maintaining the only immediate water supply for crops, is a factor of climatology, and as different types of soil maintain different quantities of water, it may be assumed for all practical purposes that crops growing on these different types of soil, even with the same rainfall and temperature, are really under different climatic conditions. This is the basis of much

of the specialization of agriculture and a principal cause of the local importance of certain districts for special crops, such as truck, tobacco, and fruit, as well as for the distribution of such farm crops as corn, wheat, and grass. The recognition of this fact is largely the basis of the soil survey and for the highest prosperity of agricultural communities. Furthermore, it is a well-known fact that the degree and character of cultivation has a marked effect upon the moisture supply of the soil, and thus controls in no little degree the climatic conditions under which the crop is grown.

In certain sections of the country and on certain soils, notably in California and the Northwestern States, the condition of the soil for various crops and the probable yield can be fairly estimated from the water supply in the soil some weeks, or even months, before the harvest.

In former reports attention was called to the progress made in the perfection of instruments for recording the moisture contents of soils in the field and for determining the tendency to evaporation or loss of water from plants for which an adequate moisture supply must be maintained. Stations were established in different parts of the country and on important soil types for these moisture records. From these records it was possible to show the normal variations which could occur in any soil between the conditions of excessive wet and drought, and the possibilities were pointed out of determining a numerical relation between the soil moisture and the sunshine, temperature, humidity, and wind velocity which would enable the climatic condition to be expressed by some figure representing the relative condition of plant growth at any place in terms of the most favorable conditions. This is in no way covered by the work of the Weather Bureau, which is concerned largely with dynamic meteorology, or the laws and prediction of storms, and will involve an entirely different equipment and an independent set of observations, taken in the fields and soils of growing crops rather than in cities and towns.

The value of such observations, taken by a corps of experts trained to observe and understand plants as florists understand greenhouse plants, can not be estimated. Reports based upon such observations in a period of drought, such as the Middle West has just experienced, would show the actual conditions existing far more accurately than is now possible. Furthermore, as the drought limit is approached in any soil suggestions can be made for preventive measures in cultivation or cropping which may save many bushels of grain on any farm, which in the aggregate for all the farmers who would heed the warnings sent out from Washington would save an immense sum of money to the agriculturists.

The time has come when this work should be again taken up on a

scale commensurate with the extension of at least two or three crop interests. It is certain that the immediate benefit to the farmers will amply repay the expenditure.

SOIL TECHNOLOGY.

The field parties see many opportunities of improvement in the crops or methods of cultivation in the districts in which they are located which they have not time, in the rapid progress of their work, to demonstrate, and for which they must rely upon recommendations in their rather brief reports. Such recommendations seldom accomplish the object sought, on account of the well-known conservatism of growers. It may be that the evidence indicates the need of drainage or the correcting of acidity in the soil, or may suggest the introduction of new and profitable crops. Such suggestions are rarely acted upon in that thorough manner necessary for a practical demonstration, and it therefore seems advisable, if the full value of the soil survey is to be realized, to organize a division of soil technology to work out the suggestions and demonstrate the efficiency of new methods or the feasibility of introducing new crops, as has been done so successfully in the case of the tobacco work.

It is difficult to find trained men for this work in this country, and the success of such an organization would depend largely upon the personnel of the force. Our agricultural colleges should turn out such men, but they seem not to have done so. There are practical men who could carry on such work under the direction of our scientists, but they are usually so successful as managers of estates that they can not be induced to accept a place for the salaries allowed by Congress in this Department. It is necessary, in this as in other lines, to train the men ourselves, unless higher salaries are paid.

TOBACCO INVESTIGATIONS.

In my last report attention was called to the success of the exhibit of American-grown leaf tobacco at the Paris Exposition and the number of awards given. After the installation of the exhibit and the work of the jury of awards had been completed the tobacco expert of the Division spent some time, under orders from the Secretary, visiting the foreign markets, particularly in Paris, Bremen, Amsterdam, and London, where large quantities of our domestic tobaccos are sold or where we ourselves purchase leaf for our own use. The information gathered in this way of the character of the tobacco from all over the world with which we have to compete in our foreign trade, of the requirements of these markets, and of the methods of selling under the *regie* system prevailing in certain of the European countries,

promises to be of great value in the investigations which it is planned soon to take up of the export types from Virginia, North Carolina, Kentucky, and Tennessee.

Upon the return to this country of our tobacco expert, Mr. Floyd, active steps were taken to start some investigations on the improvement of the Pennsylvania leaf, with the object of seeing what could be done with it, and the further object of introducing a more desirable filler leaf, if such a step seemed necessary for the building up of the trade in Pennsylvania tobacco. A soil survey had been made of the principal tobacco districts of Lancaster County as a basis for the possible introduction of new varieties. In the preliminary work of manipulating the present type of leaf grown in Lancaster County a different method of fermentation was tried, in which the tobacco is fermented in bulk, according to the practice in Cuba and Florida, which had been successfully used on the Connecticut leaf the year before.

Fermentation by this process is completed within forty or fifty days, under the constant supervision of an attendant, who turns the bulk from time to time, thus making it possible to watch the progress of the fermentation and to modify the conditions if circumstances seem to require it. This is a decided gain in point of time, and is much less expensive in the way of storage and insurance risks than the old method of case fermentation, where the tobacco was set aside for from six to nine months in a tightly packed case, in which it was doubtful whether it would escape injury by black rot.

The first experiment was made on an old crop which had not fermented by the usual case method, but which had developed a considerable amount of black rot. Bulk fermentation proved perfectly successful, the quality of the leaf being greatly improved and no further development of the black rot appearing while the tobacco was in bulk or afterwards. The results of this experiment seemed to be of such marked value that several of the leading packers of Lancaster opened their warehouses to us and installed, at considerable expense, proper facilities for handling the crop. As a result of this, during the winter and spring of 1901 over 4,000,000 pounds of tobacco were fermented in bulk under our direction, with a total loss of only 35 pounds from black rot and all other damage. This is exclusive of one of the first bulks, which was almost entirely destroyed by black rot, as the conditions for handling the crop were not thoroughly understood. It is a difficult matter to give any close estimate of the usual damage from black rot, as the dealers hesitate very often before admitting that there is any at all; but a conservative estimate would show a loss of \$500,000 or more per year in the Pennsylvania crop, and in some years it must considerably exceed this figure. The success of this method of fermenting the tobacco, both in improving the quality of the leaf, which is generally conceded, and in controlling the dreaded

black rot, about which there is no longer any doubt, is assured, and it is confidently predicted by the packers themselves that the new method will entirely supersede the old, especially where large crops are to be handled. If this is done it will mean a saving to the State of Pennsylvania alone of an amount far exceeding the present cost of the whole Soils Division.

In the early spring arrangements were made with four prominent growers on different soil types in Lancaster County to introduce some of the finer Cuban seed, and these experiments are now progressing under our control, the latest reports of the work being very promising. It will, of course, be several months before the actual results can be determined, but if they seem to warrant it all necessary attention will be given to the important experiments at this point in the endeavor to raise the quality of the Pennsylvania leaf.

In my last report I announced the complete success of the small experiment of growing a fine type of Sumatra leaf on certain soils in the Connecticut Valley. This experiment had been made on a small tract of one-third of an acre, and it was thought best to extend it to a larger area in order to see if, under the conditions prevailing and with the large cost of production, the tobacco could be profitably raised in the valley. Accordingly, in the spring of 1901 arrangements were made with a number of farmers in Connecticut and Massachusetts, in areas as widely separated as possible, and on typical soils which it was thought could be used for the Sumatra tobacco, and nearly 43 acres were placed under our immediate control. It was agreed that the farmers should furnish all needful material and labor, and that the Department should assume direction of affairs in the practical management of the crop.

The understanding is that all the necessary information regarding the actual cost of the work shall be at the disposal of the Department to publish, and that the Department itself shall have the right to sell the crop for the farmers, so as to insure an absolutely impartial judgment from the leaf dealers as to the quality and value of the product. It will, of course, be some time before the actual results of this large experiment will be available for publication. It has been estimated roughly that about \$20,000 has been invested on the part of the farmers, with no expense whatever to the Department except that of supervision.

The experiment has attracted a most remarkable interest, and prominent growers and packers have visited Tariffville, the Department's headquarters for this work, from many places in Connecticut and Massachusetts, as well as from Pennsylvania, New York, Ohio, Wisconsin, and Florida. The present indications are that the crop will yield at least double the cost of production, although nearly three-fourths of the original cost is in what might be termed permanent improvements—that is, in the erection of the shade—which will last from

five to ten years. It is probable that within two or three months from the time of the publication of this report the data will be available for the issuing of a special report on this experiment, giving the methods and cost of production and the value of the crop. It would therefore be unwise at this time to attempt to forecast the results.

In view of the phenomenal success of the introduction of Sumatra leaf into the Connecticut Valley and the control of black rot in the Pennsylvania crop, there have been many urgent demands for help in the tobacco industry in New York, Ohio, Wisconsin, Texas, and Florida. Preliminary steps have been taken to meet these demands, but they are so great that it will take considerable time to extend help even where it is most needed. Active measures are being taken, as announced in my last report, for investigating the possibilities of growing Havana tobacco in Texas, and it is aimed to make this experiment one of the strong features of our work for the coming year.

It must not be overlooked that there is pressing need of investigations in the manufacturing and export types of the Southern States, and there have been many requests for such help on the part of the Department. It has seemed wise, however, to confine our attention to the highly organized industry in the production and handling of the cigar types and to get this work well established before the other types are taken up. Just as soon as possible, however, the Virginia, North Carolina, Tennessee, and Kentucky districts will be attended to. Preliminary work is being done in several of the States in the construction of soil maps of the important tobacco areas, and plans are being perfected for the improvement of the types and grades of leaf grown there.

During the spring of 1901 a comprehensive exhibit of leaf tobacco was installed at the Pan-American Exposition in Buffalo, modeled somewhat after the exhibit at Paris, although necessarily much smaller, as the space at our command was considerably less.

Another important line which has been taken up is the securing of tobacco seed for Congressional distribution. Contracts have been made with leading growers in the various States to have seeds saved from healthy, vigorous, well-bred plants, and arrangements have been perfected for the distribution of these varieties to the districts to which they are particularly adapted. It is believed that this will be a great improvement over the former miscellaneous distribution of tobaccos of all kinds to all districts.

EXPENSES OF THE WORK.

In thus briefly reviewing the work of the Division of Soils and stating the results, the commercial value of which is already apparent in several lines, and which open up great possibilities for improving methods and crops in still others, I can not refrain from showing the

very moderate expense this work has been to the Department and to the country during the past fiscal year, as follows:

		Per cent.
Administrative expenses.....	\$10,081.68	25.3
Laboratories.....	5,929.45	14.9
Tobacco investigations.....	5,609.64	14
Eastern soil survey.....	8,828.88	22.2
Western soil survey.....	9,392.45	23.6
	<hr/> 39,842.10	<hr/> 100

It is only necessary to compare the extent of the operations of the Division, the results accomplished during the year, and the present well-organized condition of the work with the total outlay involved to show conclusively that the money appropriated has been wisely and economically expended and that the results could only have been secured by an excellent organization and by efficient and earnest cooperation on the part of all employees of the Division.

REVIEW OF SOIL WORK.

This report marks an epoch in the work of the Division of Soils, namely, the transformation of the Division into a bureau well organized and well equipped to carry on the work in a larger and broader field than has ever before been possible. In this connection certain features characterizing the work of the Division during the past year invite special attention.

Every impartial reader of this report will concede to me the right to point to the work of the Division of Soils as work which fully and thoroughly meets the supreme test of the Department's practical utility, namely, the material benefits accruing to the tillers of the soil with a very modest expenditure of public funds.

The popularity of the work of the soil survey, as shown in the numerous requests for its extension which have come from all the States and Territories, has been amply justified by the practical results already attained by our field parties. The prophecy volunteered not so long ago of the impracticability of a comprehensive and effective soil survey has been effectually disproved. To-day there is not only no difficulty in securing active cooperation with State organizations, but cooperation has been offered far in excess of our present available force. The workers in our field parties are every season acquiring new and valuable experience, which promises to make them more useful in the future. The success of their work is attracting trained men, who look to this as one of the most promising fields for research work in economic lines. The lack of trained men previously commented on has been met by thorough and conscientious training on our part of promising young men in our laboratory and field methods, so that we are practically independent in this respect and can meet any reason-

able demands which may be made for the extension of the work within the limits of the appropriation by Congress.

In our laboratories the problems of soil physics and soil chemistry are being intelligently studied and in certain lines effectually solved, but it is perhaps in our tobacco experiments that we have achieved the most striking results, measured by the immediate effects upon the cultivator and by the appreciation of the public. These experiments are based upon the soil survey, and they justify by their results the confident statement, as anyone who carefully reads this report can see, that what has already been done, to say nothing of what we hope to do in the future, has laid the foundation of added wealth to tobacco growers in this country aggregating yearly far more than the entire cost of the Division of Soils since its establishment.

With such results as have been already achieved we can certainly look forward with the utmost confidence to the results to be obtained by the Bureau of Soils with the larger appropriation and additional equipment which have been, and which may be, provided by the far-sighted liberality of Congress.

BUREAU OF CHEMISTRY.

Chemistry is a science which touches every branch of agriculture. In the organic act establishing the Department of Agriculture, among the scientific advisers which the Commissioner of Agriculture was authorized to appoint, a chemist was first mentioned. The Bureau of Chemistry is the natural outgrowth of the Division of Chemistry, which was the first scientific office established at the time of the organization of the Department in 1862. The work of this branch of the scientific service has gradually extended until it has reached its present proportions. Gradually the chemical work of the Department of Agriculture has come to be regarded as the most important of all the chemical work for the Government. The scope of the work at the present time, together with the relations which have been established by it with other Departments of the Government, can best be illustrated by a brief statement of the nature of the investigations which have been conducted during the fiscal year ended June 30, 1901. During that period there were received for examination or analysis in the Division of Chemistry 3,824 samples of all kinds.

INVESTIGATIONS OF THE COMPOSITION, NUTRITIVE VALUE, AND ADULTERATION OF FOOD PRODUCTS.

The subjects of investigation have been, first, the study of the composition, nutritive value, and adulteration of food products. The work of the year has been devoted particularly to the study of preserved meats, with a view of comparing the preserved article with the origi-

nal, in respect of its composition and nutritive value, and to determine the preservatives, if any, which are employed in the process. This is a part of the elaborate work which has been carried on for many years in this line and which is recognized throughout the world as the most important contribution to this branch of agricultural science which has ever been made. The bulletins relating to the subject of the adulteration of foods, although printed in more than the usual numbers, have been entirely taken up by the demands from scientific men throughout the world, so that none remain now for distribution. The importance of this work has been recognized in a very practical way by the publication of a volume, by high chemical authorities, on food adulteration, in which it is stated that the contents of the work consist chiefly of the investigations of the Division of Chemistry and that the justification of its publication lies in the fact that the bulletins containing these investigations are no longer available for use.

The importance of securing pure food is of equal value both to the farmer and the consumer, and the efforts of the Division of Chemistry have been for many years and still are devoted to this great purpose.

EXAMINATION OF IMPORTED FOOD PRODUCTS.

In connection with this work, by special authority of Congress, the Division of Chemistry has examined food products imported into this country which are suspected of adulteration or of containing injurious constituents. While Congress has not authorized the Department of Agriculture in any way to protect the people of this country from frauds in food adulteration, it has conferred the authority upon the Department of protecting the health of our people from injurious substances imported in foods. The investigations during the past year have been devoted particularly to olive oils, preserved meats, and wines. The greater part of these investigations is considered of a confidential nature, and the results have not been published up to this time. It is believed, however, that the time will soon come when the results of these investigations can with profit be given to the public.

EXAMINATION OF FOODS INTENDED FOR EXPORT.

With a similar purpose in view, the Congress of the United States has authorized the Secretary of Agriculture, through the Bureau of Chemistry, to inspect American food products intended for export to foreign countries where chemical and physical tests are applied to the sale of foods. Unfortunately Congress did not give a sufficient appropriation to the Bureau of Chemistry to permit the execution of this law in a proper way. It is important that our food products going abroad be pure and wholesome, and that we protect our exporters

against any unjust discrimination in foreign countries. To this end an inspection, such as Congress provided for, is absolutely necessary. During the past year this inspection was devoted particularly to exported dairy products and wines, but it is hoped that Congress will provide for the extension of this work to all food products of every description.

INVESTIGATIONS IN CONNECTION WITH ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The Division of Chemistry has continued during the year to study methods of analysis and investigation of soils, fertilizers, fodders and other feeding stuffs, tannins, sugars, and dairy products, in connection with the Association of Official Agricultural Chemists of the United States. This work, in which the Division of Chemistry has taken a leading part during the past sixteen years, has placed the agricultural chemists of this country on a plane which, for unity of action and purpose and the value of the results obtained, has enabled them to secure a higher position of authority and achievement than any of the other agricultural chemists of the world. There is, in other words, no organized body of agricultural chemists to-day which compares in efficiency and thoroughness of work with our own, and this has been due largely to the work of the Division of Chemistry, in collaboration with the agricultural chemists of our colleges and experiment stations.

WORK OF FOREST CHEMISTRY.

The work of forest chemistry in the Bureau of Chemistry is of the utmost practical importance to the investigations of forestry. This work is devoted to the study of forest products in regard to their composition, their relation to the soil, and the products which they can yield. When it is considered that many of the great technical chemical industries of the country are intimately dependent on forest products, the magnitude of this work is easily understood. Among these great interests the tanning industry stands, perhaps, first, followed closely by the industries devoted to the manufacture of wood pulp and to the distillation of wood and the production of wood spirit, methyl alcohol, acetone, pyroligneous acid, charcoal, and other products. This work is now thoroughly organized in the Bureau and will be prosecuted with still greater vigor.

WORK OF DAIRY CHEMISTRY.

The laboratory of dairy chemistry in the Bureau has been more fully equipped and organized and is devoted especially to a study of the best methods of detecting adulterated or preserved dairy products and of preventing unjust discrimination against these products in foreign countries by the application of crude or imperfect methods of analysis or in the exercise of discrimination in any way prejudicial to our interests.

STUDY OF SUGAR-PRODUCING PLANTS.

The sugar laboratory of the Bureau of Chemistry continues to study all the chemical problems relating to the production of sugar-producing plants and the manufacture of sugar therefrom. The chief part of the work is devoted to the study of sugar beets and especially to the influence of environment upon the sugar content thereof. This study is pursued systematically, in collaboration with the agricultural experiment stations, and has already revealed in a definite way the influence of the chief factors of environment, viz. temperature, sunshine, and soil, upon the sugar content of the beet.

Great interest has also lately been awakened in Georgia and Florida looking to the extension of the culture of sugar cane in those localities, and the Bureau of Chemistry has taken up a systematic examination of the soils on which the cane is grown and an analysis of the canes produced.

STUDY OF ROAD-BUILDING MATERIALS.

The laboratory for the study of road materials, established to cooperate with the Office of Public Road Inquiries, has been fully organized and is now one of the important sections of the work of the Bureau. The physical and chemical study of the materials used in building roads will lead to not only greater economy in road construction, but far greater durability. The cementation value of the materials used for surfacing a road differs so widely that the efficiency of the road depends upon the nature of this material. The investigations of this laboratory will show to road builders the exact character of the materials which it is proposed to use for surfacing and lead them to choose those which will give the highest efficiency.

The laboratory has in no way been advertised, except in the exhibit made at the Pan-American Exposition, owing to the limited facilities for carrying on the work; but even with this necessary precaution it has been impossible to keep pace with the heavy demand for tests. Samples have been received from all parts of the United States and even from our foreign possessions.

At the present time the laboratory has the equipment and facilities for testing all varieties of macadam rock, gravels, and clays, and in a short time the equipment for testing paving brick will be ready. In the testing of paving brick, not only will the physical properties of the manufactured brick be determined, but a thorough study will be made of the methods and materials used in making the various types of brick to aid the manufacturer as much as possible in improving his products. The prime object of this laboratory is to aid road builders in selecting the best available materials for their roads.

When it is considered that the cost of properly constructed macadam roads is from \$3,000 to \$10,000 a mile, and that the cost of paved

roads is generally much greater, it can be seen that selecting the proper material is a very important matter.

CHEMICAL WORK FOR OTHER EXECUTIVE DEPARTMENTS.

The work which the Bureau of Chemistry does for the other Departments of the Government is already great and is constantly increasing in magnitude. By arrangement with the Secretary of the Treasury, the chief of the Bureau of Chemistry has been designated as supervisor of sugar tests in the laboratories of the appraisers at the ports of New York, Philadelphia, and Boston. The control of this branch of the chemical work of the Treasury is of the utmost significance, as sugar furnishes a larger revenue than any other one item imported into the United States. Many suits have been brought against the United States on the alleged grounds of collecting a higher duty than the law contemplates on imported sugar, and this fact led the Secretary of the Treasury to solicit the cooperation of this Department in securing the highest possible accuracy in the scientific ascertainment of the amount of duty to be levied.

For the War Department the Bureau of Chemistry has continued to examine many of the articles of food, clothing, and other supplies for the Army, and this work is continually increasing in magnitude.

For the Post-Office Department the Bureau of Chemistry continues to examine all articles which are supposed to be unmaillable under the law or fraudulent in nature.

For the State and other Departments the stationery and inks which are used in producing records are examined in the Bureau of Chemistry.

For the Department of the Interior the Bureau of Chemistry has undertaken a thorough examination of the hot springs in the reservation at Hot Springs, Ark.

Many other miscellaneous items are submitted by the various Departments of the Government for investigation in the Bureau.

It is thus seen that not only is the Bureau of Chemistry charged with chemical investigations of all kinds which relate to agriculture, but also has gradually extended its investigations to the necessities of other Departments. It has thus gradually grown to be recognized as the leading chemical laboratory of the Government, to which all of the Departments have recourse in cases of need for chemical work. It is hoped that Congress will provide for this expanded work of the Bureau of Chemistry, since chemical work can be more economically and efficiently done under a common supervision rather than by the establishment of separate laboratories for every character of investigation.

BUREAU OF FORESTRY.

The work of this Bureau includes the making and execution of working plans for Federal, State, and private forest lands; the study of forests, forest fires, forest grazing, commercial trees, lumbering, and

forest products; the study of economic tree planting and the preparation of planting plans. The Bureau is cooperating with the Federal Government, with several States, and with many private owners in handling their forest lands. Its assistance has been asked for a total area of 52,170,036 acres, of which about 4,000,000 acres are held by lumber companies and other private owners. In its studies of commercial trees and forests, and of their forest problems, it is pursuing lines of investigation indispensable to the development and perpetuation of our national forest resources. Its work of tree planting on the treeless plains already involves the making of planting plans for many thousands of acres of wood lots, shelter belts, and commercial plantations.

On the 1st of July of the present year the Division of Forestry became a Bureau. The change was incidental to the partial reorganization of the Department of Agriculture by Congress at its last session, but it was brought about by the increased understanding of the need of forestry among our people, and especially by the appreciation in Congress of the practical methods used by this Department in its forest work. The change from a Division to a Bureau opens a way for larger organization and more extended work which the public and private demands for assistance in practical forestry have made imperative. The work of the Bureau of Forestry is now conducted along three principal lines: First, forest management, which involves the preparation and execution of working plans for Federal, State, and private forest lands; second, forest investigation, which includes the study of commercial trees, of economic tree planting, of forest fires, grazing, lumbering, forest products, and other important lines of research; and third, the making and maintenance of records, which covers the routine work of the Bureau and the care of its library, laboratory, and photographic collection.

I am glad to report that the Bureau, under its present organization, can meet much more effectively the demands made upon it than was possible as a division. During the fiscal year these demands have not only increased along lines already established, but the growing tendency to refer all important forest matters to the Bureau has been more marked than at any time in the past.

The demands for the assistance and advice of the Bureau are insistent and widespread, and its sphere of usefulness has extended widely with the sound and steady development of the forest movement. With the added effectiveness of its present organization, the adequate extension of its field force, now first made possible by the training of men in our forest schools, and the urgently growing need of its services, the Bureau of Forestry has before it a future rich in possibilities for useful work if its resources do not fall too far behind its actual needs. I have not hesitated to recommend a considerably increased appropriation for the Bureau of Forestry for the coming fiscal year,

because of the vast interests which depend on forest preservation and wise use. In a very real sense an appropriation for these purposes protects and promotes the interests, among others, of all that vast body of our citizens to whom the success of irrigation, mining, grazing, transportation, or the timber trade are of primary importance.

The rapid progress of interest in forestry throughout the South is most gratifying. A very considerable proportion of the most important recent work of the Bureau of Forestry lies in the Southern States.

With the view to encouraging the substitution of conservative for destructive methods, the Bureau has undertaken the preparation of working plans, giving full directions for the management of forest tracts, and will also afford practical assistance on the ground, without cost to the owners of wood lots. In the case of large tracts, however, the cost of traveling expenses and subsistence, together with the necessary helpers of the agents of the Bureau while in the field, must be borne by the owner.

FOREST MANAGEMENT.

The requests upon the Bureau of Forestry from private owners for practical assistance and advice in the handling of their forest lands continue steadily to increase. Of the recent requests for assistance the most noteworthy is the joint application of the Kirby Lumber Company and the Houston Oil Company for help in devising the best method of managing 1,000,000 acres of long-leaf pine land in Texas. This area includes considerably more than half of the long-leaf pine lands in that State.

Personal examinations in the woods were made during the year of 788,890 acres of private ownership, and four detailed working plans were prepared, covering an area of 226,000 acres. One of these was for the tract of a lumber company in Arkansas and another for a tract in Missouri owned by the Deering Harvester Company. The preparation of working plans was begun upon five timber tracts of private ownership, with a total area of 628,000 acres. The largest of these consists of 300,000 acres in Maine, owned by the Great Northern Paper Company. The fact that the offer of cooperation under which these working plans are made is being taken advantage of so extensively by lumber companies and other business organizations indicates clearly the real practical value of the Bureau of Forestry to private owners.

The preparation of working plans for the Federal forest reserves goes steadily on. The working plan for the Black Hills Forest Reserve has been completed, and working plans have been begun for the Prescott, the Bighorn, and the Priest River forest reserves. The immense labor involved in some of these plans is indicated by the fact that for the Black Hills plan alone the diameter of every tree, large or small, was measured on 10,234 acres, and complete ring countings were made

for 4,500 trees. All these field measurements require painstaking elaboration in the office.

In cooperation with the State of New York, which appropriated \$3,500 for that purpose, the field work necessary to a working plan for townships 5, 6, and 41, Hamilton County, in the Adirondack Forest Preserve, has been completed. The results of similar cooperation on township 40 have already been printed in the form of a complete working plan.

FOREST INVESTIGATION.

Studies of commercial trees, the practical advantages of which are becoming more and more evident, were continued during the year and extended to many species hitherto not investigated. Extensive studies of the redwood, red fir, and hemlock of the Pacific coast have been completed and are ready for publication. Other trees under investigation are the Western yellow pine, the loblolly and short-leaf pines, the more important Southern hard woods, the Adirondack balsam, and the second-growth hard woods of New England. The location, size, and ownership of the Big Tree groves in the California sierras have been thoroughly studied for the first time, and much fresh information has been obtained of the character of the tree.

The region containing the proposed Appalachian Forest Reserve was examined in cooperation with the United States Geological Survey. The forest on 9,600,000 acres was mapped, the lands were classified, and a careful study was made of the forests. The result of this examination will be embodied in a report dealing with the suitability of this region for the purpose of a national forest reserve, the cost of such a reserve to the Government, and the good which would result from its careful and conservative management.

The creation of the proposed reserve is, in my judgment, urgent, in order to protect the headwaters of important streams, to maintain an already greatly impaired supply of timber, and to provide a national recreation ground which, with the single exception of the Adirondacks, will be readily accessible to a larger number of people than any other forest region in the United States. I believe that these considerations render the purchase by the Federal Government of the proposed reserve in the Southern Appalachians desirable in every way. The policy involved is not new. The proposed purchase will not involve the creation of a precedent, for that has already been done. In 1896 the Government purchased from the Blackfeet Indians of Montana an area of approximately 615,500 acres for the sum of \$1,500,000, and on February 22, 1897, it became a part of the Flathead Forest Reserve.

A study of the Sierra Forest Reserve has been undertaken, also in cooperation with the United States Geological Survey, and will shortly be completed.

Following the request of the Secretary of the Interior for reports on technical forest matters, the effect of grazing and of forest fires was investigated in twelve of the forest reserves. A study of the present forest condition of Nebraska and of the causes which led up to it was begun and pushed far toward completion.

The Bureau is now conducting an investigation in the South to devise conservative and practicable methods for improved turpentine orcharding. Since the maintenance of the naval-stores industry is of urgent necessity in the Southern States, this investigation is one of the most important now being carried on by the Bureau.

FOREST EXHIBITS.

The forest exhibit of this Department at the Pan-American Exposition was superior in size and quality to that at the Paris exhibition, which was awarded a gold medal. It included the largest colored transparencies ever made.

TREE PLANTING.

One of the most important and promising lines of work of the Bureau of Forestry is its study of economic tree planting and its cooperation with farmers and others in making forest plantations. Tree planting has so vital and intimate a relation to the welfare of the farmer in the treeless regions that whatever assists him to grow trees assists him also in the production of every other crop. Forty-six thousand one hundred and forty-five acres were examined for planting during the year, and planting plans were prepared for 5,785 acres, while 148 applications for tree-planting plans have been received. The number of applications for commercial plantations of large size is increasing so rapidly that the usefulness of the practical assistance and advice offered to the tree planters will be limited only by the men and money available for the work.

A series of important measurements of the growth of planted groves in the treeless plains has been begun in order to show the value of plantations as business investments. A careful study has been pushed during the year of the encroachment of forests on the Western plains in order to determine the possibility of reclaiming portions of non-agricultural Government land by planting forests.

OFFICE OF EXPERIMENT STATIONS.

PROGRESS OF THE STATIONS.

During the past year the Office of Experiment Stations has made a broad inquiry to determine how far the operations of the agricultural experiment stations are conducted with special reference to the agricultural needs of their respective States and Territories. This inquiry

has shown conclusively that by far the largest part of the work of our stations has direct relation to the important agricultural interests of the communities in which they are located. It has also shown that the nature of the operations of the stations is becoming better understood by our farmers, and that the desirability of more thorough and far-reaching investigations is much more appreciated than formerly. A broader and deeper foundation of scientific inquiry is being laid each year, and there is a constant accumulation of data regarding the general agricultural conditions of the different regions of the United States. The climate, soil, water supply, native and cultivated plants, injurious insects, fungi, and bacteria are being studied in more detail and with greater thoroughness than ever before. Best of all, this scientific work is having a beneficial effect on more practical operations of our stations. These are assuming a more substantial and systematic character, and are being conducted with more definite relation to actual conditions. They have, therefore, a greater assurance of successful practical outcome.

Questions relating to the introduction of plants or to the improvement of the live-stock industry in any region, for example, are now being investigated with a strict relation to the real requirements of the agriculture of that region, which would have been impossible a few years ago. Public attention has recently been strongly and favorably attracted to the successful results of the work of our stations, in cooperation with this Department, in making it possible for our farmers to have an abundant supply of forage for their live stock under varied regional and climatic conditions. The relatively large use which is now made of such crops as alfalfa, kafir corn, cowpeas, and rape is generally acknowledged to be due to the persistent and well-directed efforts of the stations and this Department. This is a matter of very great importance to our agriculture when we consider the vast interests involved in the animal husbandry of the United States.

In some ways the past year has been notable in the progress of agricultural research in this country. The results of practical importance already attained have inspired the public with such confidence in the value of this kind of investigation that Congress and State legislatures have been unusually liberal to this Department and the experiment stations. At the same time business enterprises requiring scientific and expert knowledge and skill for their successful management have been unusually prosperous. The managers of these enterprises have awakened to a much clearer appreciation of the value of the services of such men as are most successful workers in our institutions for agricultural education and research. An increasing number of our best workers in these institutions have therefore been given very attractive offers from the business world. So many public and private positions for well-trained and experienced workers in agricultural science and

research have been opened that in some lines the demand has outrun the supply. This has led to numerous changes in the personnel of our experiment stations, partly through the transfer of their officers to outside enterprises and partly through the change of officers from one station to another on account of differences in salary and other attractions. This is a remarkable state of things considering the length of time during which our stations have been in operation, and brings them face to face in a measure with the same difficulties which attended their earlier operations, when, for different reasons, there was an inadequate supply of trained workers.

As the work of the experiment station makes a more definite impression upon the public mind, and is more clearly differentiated from that of the agricultural college as a whole, the State legislatures are called upon to make special appropriations for investigations by the stations. A notable example of this was the action of the recent legislature in Illinois, which appropriated \$46,000 for the next two years, to be expended as follows: Experiments with corn, \$10,000; soil investigations, \$10,000; investigations in horticulture, \$10,000; experiments in stock feeding, \$8,000; dairy experiments, \$5,000, and sugar-beet experiments, \$3,000. A number of States recognized the special agricultural needs of different localities by appropriations for substations or independent stations devoted to these interests.

In further recognition of the experiment station as a distinct unit within the college, separate buildings or parts of buildings are now more generally provided for the exclusive use of the station. The movement for the separation of the office of director of the station from that of president of the college has also been advanced by changes in this direction in six States, leaving at present only eleven States and Territories in which the college president actually performs the functions of director of the experiment station. In a number of instances newly appointed officers of experiment stations have no duties as teachers in the college, and in other instances changes have been made by which the amount of teaching required of station officers has been materially reduced. Experience has each year shown more conclusively that if station officers are to accomplish the best results in agricultural investigations their research work must be made their primary business before which routine duties of every kind must give way as the conditions of the original work demand. Our most successful stations are now managed on the principle that they constitute research departments of the colleges; that they are thus at the summit of our system of agricultural education, and that they must be managed on the same principles as those upon which the scientific laboratories in this Department and our leading universities are conducted—that is, their officers must be the best trained experts in their respective lines, and they must be able to devote their time and energy quite fully to their investigations.

COOPERATION OF THE STATIONS WITH THE DEPARTMENT.

The number and variety of cooperative enterprises between the different Bureaus and Divisions of this Department and the experiment stations have greatly increased during the past year. Progress has also been made in determining the principles on which successful cooperation must be based and the best methods of arranging and conducting such cooperation. Without doubt the Department and the stations are now in closer touch than ever before, and through their cooperation important investigations for the benefit of agriculture in many parts of the country have been greatly strengthened. Now that the preliminary questions relating to the organization of these cooperative enterprises have been largely settled and the funds which can be devoted to this kind of work have been increased, there will be a further extension of cooperative effort in the immediate future. By this combination of forces the varied national and local needs of our agriculture will be more fully met, and the benefits of agricultural research will be extended to every part of our territory. Thus we shall have a system of agricultural investigation more thorough in its organization and more wide reaching in its scope than exists anywhere else, and this vast system for the direct application of the results of scientific inquiry to agricultural practice has been so constituted that every farmer throughout the length and breadth of our land may easily and freely avail himself of whatever information is gained through the researches of this Department and the stations.

AGRICULTURAL EXPERIMENT STATIONS IN ALASKA.

Agricultural investigations in Alaska have been continued, with headquarters at Sitka and subsidiary stations at Kenai, on Cook Inlet, and Rampart, in the Yukon Valley. The chief new feature of these investigations during the past year has been the more thorough study of the agricultural possibilities of the interior, especially the Yukon Valley. For this purpose Professor Georgeson, the agent in charge of the Alaska experiment stations, made journeys into the interior during the summers of 1900 and 1901. As the result of the first of these journeys a tract of land on the north side of the Yukon River, directly opposite the town of Rampart, was selected for experimental purposes, and field experiments with rye, barley, oats, wheat, and vegetables were inaugurated. Rye seeded in the fall of 1900 wintered perfectly and was ripe early in August, 1901. Barley sown in the spring of 1901 ripened at the close of that season. Vegetables were largely destroyed by rabbits, and even those which escaped did not grow well in a new soil, confirming previous experience that it requires two or three years in Alaska to get new soil in proper tilth for vegetables. Vegetables are, however, successfully grown at the Holy Cross Mission and other points in the Yukon Valley. Professor

Georgeson reports that while he was at the Holy Cross Mission during the second week in August, 1901, "the mission was supplied from its own garden with new potatoes, cauliflower, cabbage, and other vegetables." At Sitka the experiments with cereals, forage crops, and vegetables were continued, and a considerable number of varieties were successfully grown. A log silo was also built there and filled with native grasses during the latter part of September, 1900, of which Professor Georgeson says: "The experiment was an entire success. Our work oxen were fed exclusively on silage from November 10 to May 1, and only when they were worked were they fed grain in addition. They ate the silage with relish throughout and were maintained in good condition. There was no greater loss of silage by waste than always occurs in preserving green forage."

At Kenai experiments with cereals and vegetables have been continued, with considerable success. Fall-seeded wheat survived the winter of 1900-1901 in fair condition, and spring-seeded oats, barley, buckwheat, flax, and wheat looked very promising early in September, 1901. A small plat of red clover sowed in the spring of 1900 wintered over well and made a good growth during the summer. The greater portion of the grain sown last spring at this station was from grain previously grown there, showing that grain can be matured and propagated in that region. Besides the experimental work at Sitka, Kenai, and Rampart, seeds have been distributed to over 400 persons living in different parts of Alaska, and a considerable number of reports have been received from seeds grown there during the season of 1900. There is a considerable increase in the demand for seeds, now that it is known that they are being distributed through the station. Not only are vegetables, cereals, and forage plants asked for, but there is a considerable demand for flower seeds. There seems to be a great desire on the part of a certain class of settlers in Alaska to cultivate flowers, which are more than ordinarily prized in a region where the general conditions of life are so comparatively hard.

WORK OF THE STATIONS AT SITKA AND KENAI, ALASKA.

During the summer of 1901 the assistant director, Dr. E. W. Allen, of the Office of Experiment Stations, made a tour of inspection to the stations at Sitka and Kenai, and also made inquiries regarding the agricultural possibilities of the coast region of Alaska. The following extracts are taken from his report:

The impression which I gained from this Alaskan trip was that not only is quite a wide range of gardening and some measure of agriculture possible, as has been shown by the Congressional reports of our experiments there, but that a gratifying amount of educational and demonstration work has been done among the people, which is already productive of good results. A number of private residences about Sitka show what can be accomplished by well-directed industry in beautifying them and in maintaining creditable home gardens. Many of the natives plant gardens of

vegetables and flowers, and a considerable number give them fairly good care. Near the town men were engaged in making hay on a small tract, and, with the weather prevailing at the time of my visit, it was quite practicable to dry the hay in the field. Numerous gardens containing lettuce, radishes, cabbage, peas, potatoes, and the more hardy vegetables generally were to be seen at the various places where I landed along the way. These gardens were for the most part well cared for and usually an object of pride. The quality of the vegetables raised was said to be excellent, and failures were few with persons who understood the best methods. At Kenai the gardens of the natives presented an especially well-cared-for and thrifty appearance. In many places the natives have come to appreciate the value of vegetable food in improving their diet, and the variety which a garden of fresh vegetables lends to the food of the newer residents of Alaska is much appreciated by them. Flower beds of sweet peas, peonies, and a number of other kinds of plants were not uncommon.

The seed for planting these gardens and the directions and encouragement for maintaining them have come very largely from the special agent in charge of the Alaska station and his superintendents. Everywhere I went along the coast region I found that the work of the Alaska stations was well known and usually very favorably regarded at present, although many admitted that they at first viewed the undertaking with much skepticism. Hardly a man was addressed who did not know about Professor Georgeson and his work. This is the more remarkable, and stronger evidence of the interest which has been aroused, when it is considered that there are practically no newspapers in Alaska having more than a local circulation, that no publications except Congressional reports have been issued, and that, owing to the difficulties of transportation, people do not get about as much as they do in the States. The extent to which information has been diffused and the confidence of the people won speak much for the vigor and industry with which the work has been prosecuted. The propaganda has met with a good measure of success, and the work now has many strong friends, particularly in the western coast region, where the conditions are the most suitable for agriculture.

I was impressed with the many difficulties which our agent has had to meet in carrying on his work under such pioneer conditions at a number of points widely separated. Transportation is entirely by water and is slow, mails are infrequent, the need for materials of various kinds must be anticipated several months, labor of the right kind for our work is very difficult to procure, the results must be accomplished in a short summer season, and a thousand and one little annoyances arise to hinder and discourage the undertaking. It is only through untiring energy and enthusiasm for the work and the exercise of the strictest economy that Professor Georgeson has been able to make the good showing that he has for the time and money he has had at his disposal. I do not hesitate to say that, despite these difficulties and the higher prices to be met, few if any of our experiment stations in the early years of their existence have been able to make a better showing for the money expended, in the way of buildings, permanent improvements to the land, and amount of experimental work performed, than the Alaskan stations do to-day, and the interest and confidence which have been aroused by the stations are worthy of any station in the newer States.

Now that such favorable results have been obtained with vegetable growing and some of the cereals, I am of opinion that work might be undertaken with animals to show the extent to which feed for them can be profitably or economically grown in Alaska. Fresh meat is scarce and dear. It is only occasionally that meat can be obtained to the west of Sitka. With small animals, like poultry, useful work might be done in showing what feeds can be grown for them and how they can best be cared for. Poultry raising would be the simplest beginning in animal production and might lay the foundation for work with larger animals. The hog is not commonly found, but summer pasturage for hogs could surely be raised, and it seems very prob-

able that winter feed could be grown also. The profitability of hog raising in a small way and the quality of the pork which could be produced without corn would be a good subject for investigation. Cattle raising and milk production have been tried as a business venture on a small scale at a few places. In most instances, however, the feed for the animals has been very largely shipped in, and it remains to be demonstrated to the satisfaction of the people at large at least that the necessary grain and feed can be profitably raised, so that products of good quality can be made without relying upon feeds imported from Puget Sound.

From the experience already had I am inclined to regard the raising of cattle for beef and for milk production in Alaska as entirely feasible. There are good pastures in places and natural meadows where hay of good quality can be made. From a commercial point of view the present freight rate on live cattle from Seattle to the Cook Inlet region would give the local cattle raiser the advantage of a protective tariff. Kenai and Kadiak seem well adapted to experiments of this nature and are representative of quite large areas of country. I would recommend that the building up of a herd of cattle with reference to conducting experiments in the feasibility and profitability of beef and milk production, using home-grown products to the largest possible extent, be taken up as soon as circumstances and the funds at the disposal of this work will permit.

From all the evidence received at this Department it seems clear that the agricultural investigations already conducted in Alaska have been productive of good results, and that by persistent effort sufficient agriculture may be established in this Territory to be an important aid in the development of mining, lumbering, and fisheries. To put the work of the stations on a more effective basis, funds should be provided for the completion of the headquarters building at Sitka, the erection of buildings at Kenai and Rampart, and the further equipment of the stations there, for the employment of an expert horticulturist, whose services are greatly needed, and for the purchase of live stock. The annual appropriation for the regular expenses of the Alaskan work should be at least as much as that for the experiment stations in the other Territories, namely, \$15,000. For the ensuing fiscal year I recommend that an additional appropriation of \$5,000 be made for buildings and the purchase and transportation of live stock.

AGRICULTURAL EXPERIMENT STATION IN HAWAII.

The first appropriation (\$10,000) for the establishment and maintenance of an agricultural experiment station in the Territory of Hawaii was made for the fiscal year covered by this report. With a view to determining the conditions existing in Hawaii with reference to experimental investigations as related to the needs of the agriculture of that Territory and the location of an experiment station, Dr. W. C. Stubbs, director of the Louisiana Agricultural Experiment Stations, was sent to Hawaii, as stated in my previous report, where he made a careful investigation with special reference to the organization and work of an experiment station. His report was transmitted to Congress in January, 1901, and published. Besides much valuable information regarding the agriculture of Hawaii, this report contains definite rec-

ommendations regarding the location, equipment, organization, and lines of work of the proposed experiment station in that Territory. It was recommended that the station be established under the direct control of this Department and independent of existing local institutions. As the station already maintained by the Hawaiian Sugar Planters' Association will continue its work on problems relating to the sugar industry, it was recommended that the station to be established by this Department give its attention to other agricultural interests.

It was pointed out that among the subjects to which the station should give special attention were the culture of fruit, vegetables, rice, forage crops, stock raising, dairying, coffee growing, irrigation, and forestry. As the headquarters for the station, it was recommended that the reservation which the Hawaiian Government had surveyed and mapped in 1893 for an experimental and forestry station be secured. This is a tract of 222 acres near Honolulu, known as Kewalo-uka, with an elevation ranging from 50 to 1,000 feet and containing cleared and forest land. On the basis of this report a second appropriation of \$12,000 was made for the maintenance of an experiment station in Hawaii during the current fiscal year. Immediately on the passage of this appropriation act I took measures for the establishment of an experiment station in Hawaii on a permanent basis. As in the case of the stations in Alaska, the general supervision of the Hawaiian Experiment Station was assigned to the Director of the Office of Experiment Stations. As the active manager of a new station Mr. Jared G. Smith, chief of the Section of Seed and Plant Introduction of this Department, was selected and transferred to the Office of Experiment Stations as the special agent in charge of the Hawaii Experiment Station. He left Washington near the end of March, 1901, and proceeded without delay to Honolulu, with instructions to establish headquarters there and to begin the organization of regular experiment-station work.

As a site for the station he was to secure possession of the tract of land in Honolulu known as Kewalo-uka, and on this to begin the clearing and fencing of land and the erection of buildings. In making plans for experimental work he was instructed—

to consider especially the needs of the people of the Hawaiian Islands as regards the production of food supplies for home consumption, and the development of animal industry, dairying, and coffee culture, and to extend aid to the people of the different localities throughout the islands for the improvement and development of local agricultural industries through the distribution of seeds, plants, and publications, the giving of advice by correspondence and otherwise, and the institution of cooperative experiments.

He was urged to enlist the cordial support and sympathy of the Hawaiian government and people in this enterprise, and he was to announce that it would be the policy of the Department "to encourage the granting of financial assistance to the station by the Hawaiian

government, as in the case of the other States and Territories where the national funds have been largely supplemented by local grants of money for buildings, equipment, and current expenses of the station."

On examination of the records of the Hawaiian government before the annexation of this Territory to the United States it was found that while there were evidences of the intention of that government to reserve the Kewalo-uka tract for experimental purposes, the reservation had never actually been completed. Soon after the annexation of the Territory, on recommendation of the Secretary of the Navy, the President issued a proclamation (November 10, 1899) reserving 20 acres, more or less, of the best agricultural land of this tract as a site for a naval hospital, and on recommendation of the Secretary of the Treasury another reservation of 7 acres has been similarly made as a site for a hospital for the Marine-Hospital Service. Through the courtesy of the Secretary of the Navy, this Department has been granted the temporary use of the naval hospital site for experimental purposes. After negotiations with the government of the Territory of Hawaii, the larger portion of the Kewalo-uka tract was definitely set aside in proclamations issued by the acting governor of the Territory for the use of the experiment station, to be conducted under the direction of the Secretary of Agriculture.

About 50 acres of land have been cleared, and half of this area has been plowed and harrowed. This includes $13\frac{1}{2}$ acres of forest land on the upper portion of the reservation, where there is sufficient rainfall to make it possible to carry on experiments without irrigation. This will be devoted to horticultural plantations, and in this way will be covered with trees again. A water system has been provided by the erection of several large tanks, which are connected with the city water system and operated with the aid of a gasoline engine and pump. The following buildings are in process of erection: Residence for the special agent in charge, office and laboratory, one frame cottage and two grass huts for laborers, one stable, and one covered manure pit.

Plantings of taro, the principal food plant of the islands, have already been begun with the special object of studying a disease which plays havoc with that crop. This is an important matter, as probably 50 per cent of the working population in these islands depend on taro for their daily food, and within the last decade the price of taro has increased 500 per cent because of the losses from this disease and the attendant deterioration in quality and yield of crop. There are many other fungus diseases of fruits and vegetables prevalent on the islands in Hawaii which should be studied. Some poultry experiments have also been inaugurated, with a view especially to finding a way of raising healthy barnyard fowls in these islands, where hitherto the supply of poultry has kept below the demand because of the losses from the ravages of diseases. It is reported that live chickens sell in

Honolulu markets for \$15 a dozen, and eggs at from 40 to 50 cents a dozen. Owing largely to the insufficient supply of forage, pork production is very expensive, the ruling price for hogs in the Honolulu markets being from 10 to 17 cents a pound on the hoof. To remedy this difficulty experiments with various tubers and roots and with the common Papaya as feed for swine will be undertaken at an early day, and as soon as possible investigations in dairy husbandry will be inaugurated. Plans are also being made for experiments in horticulture, including both fruits and vegetables, and coffee culture.

Among other subjects needing the attention of the station are investigations on methods of cultivation, use of fertilizers, drainage, irrigation, and forestry. Considering the variety of subjects for investigation, the annual appropriation for the maintenance of the Hawaii experiment station should be not less than \$15,000. To properly equip it with buildings, apparatus, implements, live stock, etc., a special fund of \$10,000 is very much needed. Now that Hawaii is organized as a Territory of the United States, I see no good reason why in the matter of an agricultural experiment station it should receive different treatment from that accorded other Territories—that is, it should regularly receive the same appropriation as is given the other Territories under the act of Congress of March 2, 1887. The further needs of the experiment station, especially as regards land, buildings, and equipment, should be provided by the people of the Territory, acting through their Territorial legislature.

PORTO RICO AGRICULTURAL EXPERIMENT STATION.

The first appropriation for agricultural investigations in Porto Rico was made for the fiscal year ended June 30, 1901. This appropriation was \$5,000 and authorized the Secretary of Agriculture to determine the agricultural conditions existing in that island, with special reference to the most desirable localities for agricultural experiment stations, as well as the subjects on which the agricultural people of the island are in most immediate need of practical information, and how this need can be most economically and effectively supplied, but it did not provide for the establishment and maintenance of an experiment station.

The preliminary investigation called for by this appropriation was made through the Office of Experiment Stations by Prof. S. A. Knapp, who visited Porto Rico during the summer of 1900. His report was transmitted to Congress and published. It contains a summarized statement regarding the climate, soil, and agriculture of the island, shows in what ways the experiment station might benefit agriculture, and recommends the establishment of a station as soon as practicable. On the basis of this report Congress made a second appropriation (\$12,000) for the current fiscal year, and authorized the Secretary of Agriculture to establish and maintain an agricultural experiment

station in Porto Rico. As soon as this appropriation was made measures were taken for the establishment of the station in Porto Rico. The general supervision of this station was assigned to the Director of the Office of Experiment Stations. As the active manager of the station, Mr. Frank D. Gardner, assistant in the Division of Soils, was selected and appointed special agent in charge of the Porto Rico experiment station. He proceeded to Porto Rico about the middle of May, 1901, and after spending some time in familiarizing himself with the conditions and needs of agriculture in the island he has arranged to undertake preliminary investigations on coffee culture.

SELECTION OF EXPERIMENT STATION.

As regards the permanent location of the experiment station, more difficulty was experienced in obtaining suitable land than was anticipated. As there is no Government land available, it will be necessary to purchase land for this purpose. An effort has been made to secure donations of land from the municipalities in the island. It was found, however, that either the municipalities possessed no lands that in kind and amount would be suitable for the purpose or that their financial condition would not allow them to purchase land for the station. It was therefore determined that action in this matter should be deferred until the next meeting of the insular legislature, when an effort will be made to secure local financial aid in the establishment of the station, as in the case of the other States and Territories. Meanwhile the headquarters of the station will be maintained at San Juan, and such investigations will be undertaken as can be pursued on lands leased or loaned by residents of the island desiring to engage in cooperative work with the station. Information regarding the agricultural needs of the island and methods which may be adopted for the improvement of agriculture on the basis of our present knowledge will be collated and published, and the people will be aided in this and other ways to improve the agricultural conditions. It is hoped that before the beginning of another fiscal year the question of the permanent location of the station may be settled and that then it may be possible to proceed rapidly with the erection of buildings, the equipment of the station with apparatus, implements, and live stock, and the making of horticultural and other plantations, as well as the institution of experimental inquiries which will place this station on a par with the others in the United States. For the regular maintenance of an experiment station in Porto Rico, as elsewhere, not less than \$15,000 will annually be required. I therefore recommend that Congress appropriate this sum for the Porto Rico station for the ensuing fiscal year.

AGRICULTURAL INVESTIGATIONS IN THE PHILIPPINES.

It is, in my judgment, very desirable that agricultural investigations should be undertaken in the Philippine Islands under the War Depart-

ment, and in cooperation with this Department. The need of such investigation is illustrated by the fact that such an important crop as rice, the leading breadstuff of the island, is not at present produced in sufficient quantities to supply the local demands. The growing of rice is better understood by the people generally than any other crop, yet by their primitive methods of culture and crude implements they are unable to adequately supply their own necessities. Of agricultural products—mostly food stuffs—up to 1890 there were imported annually more than \$4,000,000 worth, while the exports amounted to about \$14,000,000, principally hemp, sugar, coffee, and tobacco. Under the Spanish Government attempts were made to establish agricultural schools, experiment stations, and model farms, but these institutions do not seem to have exerted any important influence for the improvement of agriculture, and since the American occupation have been largely discontinued.

In instituting agricultural investigations in the Philippines it is desirable, in my judgment, to follow the precedents already made in the cases of Alaska, Hawaii, and Porto Rico—that is, a preliminary investigation should be made to determine where the experiment station should be located and what subjects it should first undertake to investigate. With headquarters for agricultural investigations once established and a single experiment station well organized, it would be easy to extend the work of agricultural research so that it would take into account the special needs of different localities. In order that there may be no delay in establishing the station after the preliminary investigation is completed, I recommend that an initial appropriation of \$15,000 be made for the ensuing fiscal year to enable me to institute agricultural investigations in the Philippines, and if feasible to locate and maintain an agricultural experiment station there. In order that these investigations may be begun at an early day, one-third of this amount should be made immediately available.

AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

Considerable progress has been made during the past year in broadening and strengthening the agricultural courses in our agricultural colleges. The movement for the division of the general subject of agriculture into specialties to be taught by different instructors still continues. The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations, of which the Director of the Office of Experiment Stations is a member, has completed its syllabus for a college course in agriculture by presenting courses in agrotechny (especially dairying), agricultural engineering, rural economics, animal husbandry, soil physics, plant pathology, and agricultural chemistry. Thus far, comparatively little attention has been given to several of these branches of agricultural

instruction in our colleges. There are, however, beginnings of a movement for the regular establishment of such courses, which there is good reason to believe will grow with the increase of the resources of these institutions and the demands of the people. There has been a considerable increase in the total number of students attending agricultural courses in the colleges, but college faculties have in many cases failed to offer sufficiently attractive four-year courses to induce students to attend, or the trustees have failed to equip faculties with teachers who have mastered their specialties. There is a growing demand for this education, and where it does not exist the college should create it as in duty bound. There is an increasing demand for short and special courses, and the colleges are meeting this to a greater extent than ever before. A much larger amount of college extension work in agriculture is now being done. In the States in which this work has been in progress for a number of years it is being successfully continued, and institutions in other States are following the example of the pioneers in this line of education. In providing for maintenance and new buildings at the agricultural colleges, the various State legislatures meeting during the past year have been more than usually liberal, so that in the aggregate there is a large increase in the resources of these institutions.

One of the most hopeful signs of progress in agricultural education is the movement for the establishment of secondary schools of agriculture and the introduction of nature study and the elements of agriculture into the rural schools.

This Department is already giving aid to the rural schools in various ways, but I believe that the time has come for the Department to take a more active part in encouraging the introduction of nature study and elementary agriculture into the curricula of rural schools for the purpose of developing the natural tendencies of the pupils to observe and take an interest in the natural phenomena surrounding them and of fostering in them a love for the country and its pursuits.

Much encouragement may be given by distributing seeds and plants for use in establishing school gardens; by furnishing schools with collections of specimens of beneficial and injurious insects, plant diseases, and other illustrative material; by supplying teachers with the publications of this Department which will be useful to them, and by such other means as would suggest themselves as the work progressed. Without doubt, the improvement of our rural schools, so that every child throughout the length and breadth of our land may have an opportunity for education which will prepare him for good citizenship and most efficient industrial service, is one of the greatest which should engage the attention of our people. With the increased interest in country life which is beginning to be manifested in different parts of the country, there is good reason to hope that our rural

schools will be much improved in the near future, and especially that they will be so organized and maintained that in them the children will be shown the attractive side of country life and will be taught the dignity and worth of rural occupations, so as to incline them toward the study of the sciences that relate to agriculture.

FARMERS' INSTITUTES.

The farmers' institute movement in this country has now become national in its extent and in the scope of its interests, and has even assumed international relations as connected with similar movements in other countries. Having their origin in farmers' societies of various kinds, some of which date back half a century or more, the institutes have been developed through the efforts of farmers' organizations, the agricultural colleges and experiment stations, boards and commissioners of agriculture, and many individual leaders in agricultural progress, until they are now annually held with more or less regularity in nearly all the States and Territories. Beginning about thirty years ago the States have one after another shown their interest in this movement through their legislatures by appropriations to aid the institutes. Growth of interest in the institutes among the farmers has been reflected by a steady increase in the number of States thus providing for their maintenance and by the larger amounts of money devoted to this purpose from year to year. According to statistics published by the Office of Experiment Stations, in 1891 about \$80,000 was spent for farmers' institutes in the United States, and of this sum about \$60,000 was specifically appropriated for this purpose. In 1899 the specific appropriations for institutes aggregated a little more than \$140,000, more than twice the sum appropriated in 1891, and the estimated expenditure of funds derived from other sources was \$30,000, a grand total of more than \$170,000 spent for institutes that year. The statistics of the institutes for the past year have not yet been collated, but the incomplete returns already received show that the State legislatures of last winter were more liberal than ever before to this enterprise.

While the statistics of the institutes collated by the Office of Experiment Stations in 1899 were not entirely complete, they showed that that year over 2,000 farmers' institutes were held in the United States which were attended by over half a million farmers. The institutes were held in 43 States and Territories. In 19 of these they were in charge of officers of agricultural colleges or experiment stations. In 17 they were under State or county officials, and in 7 they were under the joint control of State officers and college or station officers. Successfully conducted institutes are found under each system of management.

Under different names meetings of farmers in many respects similar

to our farmers' institutes are held in other countries. In some European countries in particular itinerant instruction for farmers is very thoroughly organized.

While in some of our States the farmers' institutes are quite thoroughly organized, have liberal financial support, and reach the farmers quite widely, in many of the States and in the Territories the movement is yet in a comparatively weak condition and the organization and means for this work are inadequate. Moreover, even in the States where the institutes are most thoroughly organized and have had the greatest success, new problems relating to their management have arisen with the growth of the movement. For example, there is increasing difficulty in some States in securing workers thoroughly qualified for this kind of service who can attract large audiences of farmers and hold their attention throughout the meetings.

It is a common experience that after the institutes have been held for a number of years in a given locality the farmers are not so ready to listen to local speakers or those who have nothing to give them except what has come within the range of their own limited personal experience. They demand that the institute workers shall have a wide range of knowledge regarding the science and practice of agriculture, and particularly up-to-date information regarding the progress that is being made throughout the world in studying problems in agriculture both at the experiment stations and on the farm. This has led to a demand on the officers of our agricultural colleges and experiment stations for service at the farmers' institutes far beyond their ability to meet. There is, therefore, need of developing a class of institute workers who shall combine successful practical experience and scientific knowledge of agriculture with the ability to address large audiences of farmers in a way not only to hold their attention but also to impart to them definite information and instruction. Another problem of increasing importance relates to the ways and means of reaching the masses of our farmers through the institutes. On the supposition that 500,000 farmers now annually attend the institutes, it will be seen that out of 10,000,000 farm workers in the United States only 1 in 20 is directly reached by the institutes. These are, without doubt, in the main the most intelligent men in the business, and whatever good they receive from the institutes is disseminated to a considerable extent among their less aggressive and more careless associates. But the institutes should directly reach a far greater proportion of our farmers. To do this various expedients will have to be adopted to adapt the institutes to the needs of the different classes of our agricultural population.

These examples of institute problems have been given to illustrate the fact that this movement has now reached such a stage of its development that the comparatively simple methods hitherto followed

in the organization and maintenance of the institutes are not adequate for an enterprise of such magnitude as this has become. The solution of these problems will require much study, involving a comparison of methods employed in the different States and countries. In its national and international aspects there is, in my judgment, room for much useful work by this Department which may well aid in this as in other movements for the education of our farmers and the improvement of our agriculture. While the Department has already done something toward helping institute movements, I believe that it should be put in a position to organize work in this line more thoroughly, and I have therefore decided to ask Congress to make a special appropriation of \$5,000 to enable the Office of Experiment Stations to enlarge its work with a view to giving definite aid and encouragement to the farmers' institutes in the different States and Territories. This may be done by collating and publishing information regarding the institute movement at home and abroad, by furnishing the institute workers with the Department publications and information through correspondence, by advising and assisting the institute managers in different parts of the country with special reference to perfecting organization and strengthening the work in weak places, and in general the Department may act, through its Office of Experiment Stations, as a sort of clearing house for the farmers' institute movement as it has done in the case of the agricultural experiment stations; that is, it would be a center for the focalization and dissemination of information and influences which may serve to develop farmers' institutes and make them a more efficient means for the education of our farmers and the improvement of our agriculture.

I am convinced that the publications of the Department and the experiment stations do not in themselves constitute all-sufficient means for the dissemination of information on agricultural subjects among our people. While the work of the Department and the stations has already been so far disseminated and applied that it has made important changes for the better in our agriculture, the spread of the influence of these institutions is comparatively slow because the means for directly reaching the farmers which they now possess are inadequate. The farmers' institutes may in a great measure supply this lack. When properly organized, they will bring to the masses of our farmers the information which they need to enable them to understand and apply the results of the work of the Department and the stations, and will impress upon them by practical illustrations and demonstrations the benefits which advanced scientific knowledge may confer upon our agriculture. Through the institutes, as in the case of other educational agencies, the living teacher coming in contact with the living worker can produce results which it is hopeless to expect from printed documents however well written and illustrated.

INVESTIGATIONS ON THE NUTRITION OF MAN.

The investigations on the food and nutrition of man during the past year have included dietary studies and cooking, digestion, and metabolism experiments. They have been conducted in various parts of the United States in cooperation with the experiment stations, agricultural colleges, and universities. Seven technical bulletins, two farmers' bulletins, and a Yearbook article on these investigations have been published during the past year.

The evidences of popular and scientific interest in investigations on the food and diet of man continue to multiply. The results of the investigations of the Department are being incorporated in other investigations and in scientific works on this subject, and the apparatus and methods devised by our investigators are being adopted both at home and abroad. Our publications are being used in unusual extent in connection with the courses of instruction in domestic science in schools of all grades in this and other countries, and are also much sought after by women's organizations interested in the promotion of home economics.

The lines and methods of investigation of the problems of the nutrition of man have now been so far worked out that it seems desirable that some features of this work should be conducted on a larger scale than hitherto, with a view to a more definite application of their results to practical affairs. For example, while a considerable number of dietary studies have been made, these have by no means covered the variety of conditions existing in different parts of this country and among people of different occupations. A more systematic and thorough attempt may well be made to collect reliable data regarding the food habits of our people. We need especially to study the food consumption of our farmers and rural and urban wage-workers in different regions, with special reference to their hygienic and economic requirements. Again, it is believed that the results of nutrition investigations already made may be practically and beneficially applied in a wide way to the feeding of man wherever a considerable number of persons are to be fed on a systematic plan. This applies especially to boarding schools, college clubs, reformatory and penal institutions, and hospitals for the insane and other dependent classes.

A beginning has already been made in this direction, but there is still room for a large amount of investigation before definite suggestions of general application can be made. The importance of this subject may be illustrated by reference to the hospitals for the insane in the State of New York, in which the special agent in charge of our investigations has already made some studies under State auspices. The annual cost of the food supply to these hospitals has been over \$1,000,000. The investigations already made show that not only may the total cost be

considerably reduced and large wastes prevented, but that the dietaries of the inmates of these institutions may be much improved by attention to the facts and principles established by nutrition investigations. These preliminary investigations have also shown the need for more accurate inquiries regarding the food requirements of different classes of persons in these institutions. In the State of New York alone not far from 100,000 people of the dependent and delinquent classes are maintained in public institutions at an annual expense of \$26,000,000, of which about \$6,000,000 is expended for food. This will give some indication of the vast interests at stake in this matter when we take the whole country into account. Certainly here is a field of investigation upon which the Department might well enter, and in which results of great practical value might be expected.

For the extension of nutrition investigations in the two lines above mentioned, namely, (1) dietary studies of farmers and rural and urban wage-workers, and (2) studies with reference to the utilization of the results of nutrition investigations in public institutions, I indorse the recommendation of the Director of the Office of Experiment Stations that \$5,000 be added to the present appropriation for the nutrition investigations.

Now that the governmental, commercial, and other interests of our people are so largely concerned with tropical regions, the determination of the food habits and requirements of people living in such regions has become a matter of much importance. The continuance of soldiers, sailors, and civil officers of the United States in such regions would of itself justify the institution of investigations to determine the best dietaries for their use while there. With our rapidly expanding commerce and the going out of considerable numbers of our people to reside in tropical regions, there is additional reason for undertaking such studies. Moreover, we need to study the dietaries of the native populations which have recently come under the control of the United States, with a view to determining the relation of their food habits to their health and industrial efficiency. Such investigations may easily become an important factor in the agriculture, trade, and commerce of these regions, as well as in the formulation of plans for the improvement of the conditions of life among these peoples. I have therefore indorsed the recommendation of the Director of the Office of Experiment Stations that a special appropriation of \$5,000 be made to enable this Department to undertake studies of the food supply and consumption of people living in the Tropics.

IRRIGATION INVESTIGATIONS.

The irrigation investigations conducted through the Office of Experiment Stations have been extended during the past year as far as the appropriation of \$50,000 would permit. These investigations have

followed two general lines in accordance with the terms of the appropriation act: (1) Studies of irrigation laws and the social and industrial institutions of irrigated agriculture; (2) investigations of the methods by which water is conserved, distributed, and used.

IRRIGATION LAWS.

The significance of the facts disclosed by the study of irrigation laws can be appreciated only by those familiar with Western conditions, which are in striking contrast to those of the East. In the East moisture comes from the clouds; in the West farmers must secure it from other sources. In the East irrigation may supplement rainfall; in the West it must take its place. Not only is the availability of streams for irrigation the measure of settlement, but the character of the social and industrial life of those who depend upon them will be profoundly influenced by the laws and customs which govern the ownership and control of water.

The most impressive fact connected with irrigated agriculture is the dominating influence of streams on the peace and success of cultivators of the soil. The character of the titles to water finally recognized will do more than all other influences combined to determine whether Western farmers are to be tenants or proprietors. This makes it of vital importance that the disposal of the water resources of the West should be hedged about by every safeguard which experience can suggest. Every consideration which justified the General Government in organizing a bureau for surveying, mapping, and disposing of the public lands applies with equal force to the orderly and just establishment of titles to water by public authority, either State or national.

Unfortunately, however, the importance of this was not recognized at the outset, hence the management of the public land has no counterpart in the disposal or division of Western rivers. Whoever desires to acquire public land can learn from official records just what land is open to entry and what has been disposed of. The need of reliable information regarding the amount of water appropriated and the amount still remaining under public control is more urgent, because men can see with their own eyes what lands have been settled upon and improved, but the appearance of a river gives no clue to the ditches which divert it 50 or 100 miles above or the claims which may be filed on its waters below.

Thus far all of the laws governing water rights in irrigation have been passed by the States, and all of the titles to water thus far established are either the creation of State statutes or the results of decisions of State courts. A few States have enacted enlightened codes of water laws. In these the water-right records are a reliable guide to those seeking to irrigate land and a protection to those who have already done so; but there are other States where investors in irriga-

tion works and incoming settlers must depend on what they see or on the statements of other settlers in determining what is their prospect for securing the water supply needed in irrigation. Neither of these sources of information can be relied upon. As a rule, those who have rights to water do not encourage the filing of additional claims and are inclined to say that all the water is appropriated, while newcomers are inclined to believe, if there is any water running in the stream, that it is open to their use. The tendency, therefore, is to build more ditches than the stream will serve, but it is especially marked where conditions for ditch building are favorable. As there are no limitations on the number of claims which may be filed or the number of ditches which may be built, the establishment of new rights goes on until there is not water enough to fill all the ditches, when controversies and conflicts inevitably arise. For such conflicts the only means of settlement thus far provided is a resort to force or the courts. In the States where rights to water are determined by ordinary suits at law, litigation is almost continuous and is exceedingly burdensome. It too often happens that such suits, instead of settling the nature of water ownership, only create new issues, which in turn burden the courts and impoverish water users.

This condition of affairs should not continue. The growing demand for water for irrigation purposes, the greater needs of cities and towns for domestic uses, the importance of streams in the generation of power, are making it absolutely necessary that some simple and final method of determining and protecting rights to streams shall be provided. This Department is lending all the aid its means will permit to bringing this about, and with most encouraging results. No feature of these investigations has met with more appreciative recognition than the study of water-right problems, and the meritorious character of the laws enacted last winter by several arid States and Territories shows that the Department's work is bearing fruit. The importance of these investigations is not to be measured, however, by results already achieved, but by their influence on the future social and industrial life of the West.

The report on irrigation in California recently published by this Department presents an impressive picture of the manner in which development has been hampered by lack of adequate water laws. The chaotic and conflicting records of claims, the uncertain limitations on riparian rights, and the failure to protect all rights by the public division of the water supply in times of drought has been a source of anxiety to the user and of expense and loss to the not less worthy owner of ditches and canals. The marvelous natural advantages of the State have been sufficient to offset these drawbacks, but the larger and better use of water in the future is dependent upon their removal. Especially is this true if the Government is to construct irrigation works.

Under present conditions no one knows who would control the water made available by public funds. No one knows whether the needy user or the speculative holder of a water title would reap the benefits of this expenditure. The report on irrigation in Utah, soon to be published by this Department, shows with equal clearness the need of laws to insure stability and justice in the distribution of the water supply. These reports will be followed by similar investigations in other arid States. They will present the facts. With these before them the people of each State can determine what action, if any, is required.

Reform in irrigation laws will be final and satisfactory only when it comes through the enlightenment of the people most concerned. In a matter so vitally affecting the home as the control of the water supply no legislation will be effective which has not the sanction of the irrigators themselves. As yet, this kind of agriculture is new and its requirements are only imperfectly understood. Material development has outrun the creation of institutions necessary for its protection. The last is the most difficult problem, and it is the one now directly before us. The possibilities of irrigated agriculture are so great that everything which will contribute to its largest and best development is a matter of national interest. We are now in the momentous years when institutions are forming, and the labors of this Department to foster tendencies in the right direction and to correct mistakes before they have become fixed by time and custom should be continued. What is done now affects not only the present generation of irrigators, but will vitally influence those of the distant future.

DISTRIBUTION AND USE OF WATER.

The design and improvement of instruments for measuring the water used in irrigation have received the further attention of the experts employed in this work, and have resulted in registers being furnished to irrigators at about one-half the cost of foreign instruments made for this purpose. Accurate measurement of water tends to promote economy, because it enables farmers to know whether they are receiving what they pay for and canal companies to check wasteful use wherever it occurs.

In addition to improving instruments for measuring the depth of water flowing in canals, a station has been established at Cheyenne, Wyo., for rating current meters and testing water registers. This station has been of marked service to the irrigation interests of the surrounding States.

The studies of the duty of water have been extended so as to embrace all the problems of a river. The results show that the volume of water required to irrigate an acre of land along some parts of a stream will irrigate two or three acres in other places. They also show the need of preliminary study of this subject in order to rightly locate ditches and

canals. The water supply in the same river gains in some places from seepage and loses in other places. An illustration of the change in volume due to this action was shown last season by Snake River, in Idaho. At one place in its course it carried enough water for 200,000 acres of land. Forty miles above it was dry. Nothing had been added to it by surface streams in the intervening distance. Where it was dry the water had sunk into the sand; farther down it reappeared on the surface.

The studies of evaporation and seepage have been extended in order to show more clearly the extent of the losses from canals from these sources. Much interest is being manifested in these investigations by managers of canals. Definite information on the subject is needed by those who are planning new works and to enable the managers of the old ones to distribute their water supply to the best advantage.

The operation of canals which divert streams flowing over sandy beds, or which are heavily charged with silt, has proven a source of great perplexity to those in charge, and the influence of sediment in the maintenance of reservoirs deserves careful consideration in the location of these works. Much valuable information on this subject has been gathered during the past year.

In some of the older irrigated districts the percolation of water from canals, or its wasteful use on fields, has created bogs and marshes on the lower lands. To make these over-watered fields again productive drainage will have to supplement irrigation. The plans for drainage should be made, like those for the original watering, on a comprehensive plan. The individual irrigator can not drain his own farm without the cooperation of his neighbors. Plans for effective cooperation are needed, and the aid of this investigation has been asked in their preparation.

IRRIGATION IN HUMID SECTIONS.

Interest in irrigation in the humid regions of the United States is constantly growing. This has been stimulated throughout the Middle West by the drought of last summer, and in the South and Southwest by the success of the rice industry. In the State of Louisiana more miles of irrigation canals have been built and more money expended on pumping plants during the past two years than in any arid State. The application of irrigation in growing rice in Louisiana and Texas has made land worth originally from \$5 to \$10 per acre worth \$50 to \$100 per acre, and promises to enable the United States to become an exporter instead of an importer of this important food product.

A recognition of the increased interest in irrigation in the East has caused this Department to extend its investigations in this part of the country. The experiments being made by Prof. R. C. Waters, of the Agricultural Experiment Station of Columbia, Mo., are attracting

wide attention in that State, while the investigations of Prof. F. H. King, of the Agricultural Experiment Station of Wisconsin, at Madison and Stevens Point, and of Prof. Edward B. Voorhees, of the Agricultural Experiment Station of New Jersey, will serve to show the value of irrigation in securing larger yields and providing an insurance against drought. The indications are that irrigation is to have a wide field of usefulness in many sections where it is not a necessity. Especial attention has been paid during the past year to the subject of rice irrigation, and a comprehensive report dealing with the methods of application, the cost of water, and the value of the product will soon be ready for distribution.

The fact that the United States is destined to become one of the leading irrigated countries of the world makes it especially desirable that the laws which control the ownership of streams and the methods of applying water should represent the best thought and experience of our time. Nothing can be more foolish than to continue to learn experimentally for ourselves what is already known elsewhere. The lessons of southern Europe should be placed before the growing communities of the West through reports of experts familiar with our conditions, and who can thus compare their methods and ours. The first of such investigations, embracing Italy and Egypt, is now being carried on.

In no year since Western settlement began has the prosperity of the irrigated farm been as marked as during the one drawing to a close. The high prices of cattle and sheep have contributed to the profits of the grower of forage crops. There has been a ready market and good prices for all the surplus products of the irrigated farm and garden, and these high prices have been accompanied by an almost uniform record of large yields.

AGRICULTURAL ENGINEERING.

The prosecution of these investigations has led to the study of a number of affiliated subjects, the relation of which to irrigation becomes apparent only with a thorough understanding of the situation. In one way or another the whole subject of agricultural engineering is involved. Especially is this true of the applications of power to farm work. The subject of pumping will serve as an illustration of this relation. In many places pumping furnishes the most economical and readiest means of securing a water supply. Farmers desire to avail themselves of all the experience of others before wasting any money in gathering it for themselves. Hence this Department is called on for information as to the amount of water required for a given acreage, the size of pump needed to furnish it, the cost of pumping for different depths, the kind of power to be applied, whether steam, wind, gas, water power, or electricity, the cost of machinery, the expense

of its operation, and, in general, all the aid this Department can furnish in determining in advance whether or not this kind of irrigation will pay.

The commercial importance of these inquiries can be understood only by those who realize the immense sums of money which in the last two years have been invested in pumping projects to furnish water. In the rice fields of Louisiana alone several hundred thousand dollars have been expended. This work is as yet in its experimental stage, and this Department is doing a very useful service in answering these inquiries. Another illustration of the manner in which the investigations in irrigation are naturally going into a broader field of agricultural engineering is shown in the way studies of the problems in irrigation engineering have to be supplemented by a knowledge of drainage engineering. Questions are also constantly arising regarding systems of water supply and sewerage of farms and the methods of engineering which will best promote the sanitary welfare of our agricultural people. Many inquiries are coming from Eastern States for information regarding the construction of reservoirs and advice about the handling of water in order to prevent the destructive erosion of hillside farms. We are beginning to realize that the wasteful methods of tillage employed during the conquest and settlement of this country must now give place to more scientific methods, which will restore what is lost as well as preserve what remains. In many parts of our country efforts are being made to improve the conditions of rural, as well as city and village life, by beautifying the environment of the home and the community through attention to the artistic laying out of gardens, lawns, large estates, and parks. For the performance of this work in the best manner the services of expert agricultural engineers are required, and already we find here and there engineers who are giving special attention to these subjects. In various other ways the aid of the Department is also being invoked. Without doubt, agricultural engineering is destined to have as useful a place in this country as it already occupies in European countries, and it is time that the Department should occupy this field of research and aid in the development of our agriculture along this line.

NATIONAL AID FOR IRRIGATION.

There is every reason to believe that irrigation will, in the near future, become a subject for legislation by Congress, and there are important reasons why it should have the attention of that body. Hereafter the seekers for homes on the public domain must look for them in that part of the country where cultivated crops can not be grown by the aid of rainfall alone, and where the extent of irrigation is the measure of settlement. It has been the policy of this country in the past to dispose of its public lands on liberal terms, in order that men

of limited means could be enabled to establish themselves thereon. If this policy is to be continued, more favorable conditions for the reclamation of the remaining irrigable public land must be provided. The largest volumes of unappropriated water now existing are to be found in the great rivers of the West, of which the Missouri, the Colorado, and their more important tributaries are the notable examples. To make these streams available, costly and enduring dams and long and expensive main canals must be provided. If the outlay for these is to be added to the expenditure which each settler must make in building his lateral ditches, putting his land in condition for cultivation, and supporting himself and family during the period of this preparatory labor, the expenditure will be prohibitive for all except men of considerable means. Because of this, agricultural development in the West has for several years been slow, and the period of rapid progress has probably passed, even under the most favorable conditions which can be provided.

The desire of the West is not solely, however, for a more rapid agricultural growth, but a more satisfactory one. The uncertain character of water rights has already been referred to. It is the belief of those best informed that this can be remedied only by a larger measure of public control and the making of certain classes of irrigation structures permanently public works. Among the irrigation works which belong to this class are diverting dams of such size and importance as to influence the safety of all who live below them, the main trunk canals of too great magnitude and cost for private enterprise, and reservoirs built in the channels of streams used for irrigation. The argument in favor of making such reservoirs public works is that they should not be owned by private parties because the distribution of water from them, in connection with the ordinary flow of streams, creates complications which should be averted. As their chief utility is to make possible a larger and better use of the water supply by storing the floods and supplementing the streams during the periods of drought, the same argument which justifies the setting aside of forest reserves and the payment of salaries of men to patrol them applies to the construction of reservoirs by Congress. The purpose in each case is to conserve and render available the water resources of the West.

The appropriation of money by Congress to construct any of these classes of irrigation works will bring this country face to face with a new governmental policy. Thus far we have left the diversion of streams to private ownership. The construction of public works with either State or national funds means practically a reversal of this policy and carries with it a larger measure of public control over the water resources of the West than has hitherto been practiced or sanctioned by public sentiment.

Congress, in dealing with this matter, will have to consider the man-

ner in which aid can be most effectively extended, as well as to determine the amount of such aid. It must be borne in mind that we are not at the beginning of irrigation development. Over two hundred millions of private capital has already been invested in the construction of irrigation works. The rights to streams already acquired represent many additional millions. The methods and customs by which these properties are operated and rights to streams established are the result of an evolution local in character; hence they differ widely in the different States. An illustration of the situation which prevails is furnished by the South Platte River and its tributaries in Colorado. There are over a thousand separate and distinct rights to the water of this stream. Some of these rights serve to irrigate over a hundred farms. The water right of one canal provides for the irrigation of over four hundred farms. Practically all of these thousand appropriations have reference to a common supply. Each right has a different rank, and the division, extending over thousands of miles of the main stream and its tributaries, must be carried out with reference to relative priorities. Such a division is a complex and difficult problem. It has required nearly half a century for the people of this section to solve it and devise a working system, but as a result of their experience each irrigator has come to understand his own rights and those of his neighbor, and has learned what to expect when the stream is low and what he can rely upon when it is high.

It is a question whether any appropriations which Congress might make for the construction of additional works in this district would not inflict more injury than benefit if such construction carried with it any disturbance or interference with the existing system, which people understand and to which they are attached.

The water laws of Colorado differ from those of other States. In Utah rights are established in a different manner and are of a different character, and these rights are enforced by a different body of officials. There are still other differences in Wyoming, and much more striking differences in California. This does not mean that any of these systems are entirely satisfactory. All would be improved by modification, but the change from present conditions should be made only when the people whose interests are at stake are ready for it.

The passage by Congress of any law giving the General Government control over irrigation in the West would mean, first of all, the employment of a large number of new officials and the formulation of an administrative policy to take the place of those now existing in the States. It would impose upon national officers the duty of determining what claims to water should be recognized and those which should be disregarded. As State laws differ from each other, any plan which Congress might adopt would have to be revolutionary in some States. If it were certain that the National Legislature would devise a

just and effective system which would operate everywhere alike, the unsettling of existing conditions might not be so objectionable, but there is no such assurance. All who have studied the subject agree that, notwithstanding the imperfections of State laws, it would be a mistake to attempt reforms by an arbitrary exercise of power from without, but that the true solution is to educate irrigators as to their highest interests.

If the States are to control the water supplies, there should be satisfactory assurance that whatever is made available by public funds shall benefit the actual users of water and not enrich the holders of speculative rights. In some States there is such assurance. These States are entitled to national aid, because it is known from present conditions that such aid would be clearly beneficial. But there are other arid States where the doctrine of riparian rights jeopardizes the success of every irrigation work now built, as well as any works which the Government might build. In other States rights have been established to many times the existing supply, yet there is nothing to prevent new claims being filed, new diversions made, and unending litigation over the conflicts thus created. For the Government to provide an additional supply on these streams before existing controversies are settled would simply aggravate and intensify the evils of the present situation. Whatever aid Congress extends should be conditioned on the enactment of proper irrigation codes by the States, and be made to promote the greater efficiency and success of such laws rather than interfere with their operation.

INFLUENCE OF LAND LAWS ON IRRIGATION DEVELOPMENT.

The irrigation problem of the arid West is not, however, one of water alone, but of land and water. The character of the laws which control the disposal of the 500,000,000 acres of arid public land can not but have a vital influence on the rapidity and success with which irrigated agriculture is extended. The management of these lands is a great economic trust of the nation and affords one of the highest tests of the capacity of the Republic to deal with problems of this character.

There are several directions in which land legislation can be made to promote agricultural development. Laws to protect investments of private capital in irrigation works are urgently needed. Many of the losses experienced in the past by the builders of large canals have been due to misfit land laws. The reasons for this are well understood in the West, but apparently not realized elsewhere. One has been the injury wrought by speculative filings on the land to be irrigated. The building of a canal enhances the value of the land it covers from that of grazing land to that of farming land. With a few exceptions this increase in value is at least tenfold. Under former public land laws it was possible to make filings without any outlay

except land-office fees or without making any substantial improvements, hence every canal survey has been the signal for a rush to the land office to file on the country to be watered. A majority of those making these filings were not actual settlers, but speculators seeking to make money by selling out their claims to the ditch company, or later to those who actually wished to farm the lands.

While all the land laws were doubtless intended to benefit settlers, they have in practice, in the arid region, too often benefited speculators. Hundreds of filings made under the desert, preemption, homestead, and timber-culture acts have been made by people who never were farmers and never expected to become farmers. It is to such filings that scores of meritorious irrigation enterprises owe their failure. The repeal of the preemption and timber-culture acts, and cutting down desert land entries from 640 to 320 acres, has improved the situation, but it can be still further improved by an entire repeal of the desert-land act and by requiring settlers on homesteads to cultivate as well as to live on their farms. The desert act was an economic mistake. Six hundred and forty acres is more arable land than a man of moderate means can cultivate under irrigation.

GRAZING LAND.

Surrounding the irrigable valleys are vast areas of grazing land which can never be cultivated because of lack of water, or because the surface is too broken for irrigation. Although a single acre produces little forage, the aggregate value of the pasturage is very great, and large sums of money and many men are employed in the range stock industries. Probably 400,000,000 acres of the public domain has no agricultural value except for pasturage. At present it is an open common with no laws for its protection or its disposal.

The question to be considered is whether this lack of the control of the grazing lands is an injury or an aid to the irrigation development. That it must exert an important influence can scarcely be doubted.

In sections remote from railways or local markets the prohibitive cost of transportation renders the growing of farm products for sale unprofitable. These products must be consumed where raised, and the only product that can be so consumed is winter feed for stock, and this in turn requires stock to consume it. Many irrigable areas are 50 or 100 miles from a railroad station. The use of grazing lands is as essential to successful irrigation of these areas as control of a water supply, but so long as there is no law giving secure tenure on grazing land the farmer under irrigation is subject to the danger of having his home pasturage eaten up by some nomadic flock or herd. This frequently occurs, and the gravity of the conflicts it provokes is serious. During the summer months not a week passes which does not witness an armed encounter either between settlers and range stockmen or

among the range stockmen contending for the control of the same grazing area. If, instead of this uncertain and uneconomic system, there could be a law for the control of the grazing land which would unite with a small homestead of irrigated land a larger but limited area of grazing land, thus enabling each farmer to raise his winter feed supply on his irrigated land while keeping his stock on the grazing lands in summer, the value of irrigation works would be much enhanced and a great incentive given to development by private capital.

The purpose of such union of the irrigable and grazing lands would be to divide the grazing land into a multitude of small holdings and thus increase the number of people benefited by it; to give security of tenure, which will make the growing of live stock attractive to many who are now repelled by the risks and controversies of the open range; to give increased value to irrigation, and provide the conditions indispensable to success in many localities. Such a land system would also encourage the introduction of improved breeds of stock, because it would afford better opportunities to care for them. At present there is little inducement to such improvement, because of lack of control over the country occupied. It would enlist self-interest in the improvement, or at least the preservation, of the native grasses, where every influence now tends toward their destruction.

Such a union of the irrigable and grazing lands would cause the building of fences and the making of other improvements far beyond the limits of irrigation. It would attach settlers to the pastured areas as closely as they are now wedded to their irrigated fields. It seems to possess many advantages over the present system, or lack of system, if a satisfactory law can be enacted bringing it into operation. Whatever is done, no obstacle should be placed in the way of homestead settlement, but this does not seem to offer any special difficulties. In the first place, the grazing area should be leased and not sold. The possibilities of its utilization have not yet been determined, nor is enough known to fix definitely the limits of a grazing homestead. The leasing of the grazing land in such a way as not to interfere with the homesteader can be accomplished in one of two ways: Public lands can be classified and the boundaries of irrigation and grazing defined, or the grazing land can be leased subject to entry under the public land laws. Even under such restrictions it is believed that the greater part of the grazing lands can be leased, and the rentals therefrom would amount in the aggregate to a very large sum. This could appropriately be applied to the reclamation of the irrigable lands. It would be taking nothing from the revenues of the nation, because it would come from the better use of a resource which now produces nothing.

There are also many things to commend the expenditure of the revenues derived from the sale of public lands to the construction

of irrigation works. Such an expenditure will enhance the value of the remaining lands, open up larger areas to settlement, and add to the material wealth of the country in a much larger measure than will the retention of these lands by the Government in their present condition.

The leasing value of the grazing lands has been demonstrated in a number of arid States. When Montana, Wyoming, Washington, and Idaho were admitted to the Union, a condition was attached to the donation of State lands which prevented their sale for less than \$10 an acre. This was a prohibitive price, as the adjoining areas of public land could be acquired for nothing under the homestead act. Hence the only way a revenue could be derived was through their rental. As the greater part of these lands are comprised in sections 16 and 36 and only represent the value of pasture lands, they afford a fair indication of the rental possibilities of the grazing areas. The following table shows what has been done by several States in this matter, and is a significant indication of what is being lost through lack of management of the public lands of this character:

Summary showing results of leasing State lands in some of the arid States.

State.	Total area of State lands undisposed of.	Acreage under lease at close of last fiscal year or biennium.	Total rents received.	Average rental per acre.
	<i>Acres.</i>	<i>Acres.</i>		
Colorado	2,639,938	1,251,770	\$103,121	\$0.082
Idaho		32,271	23,050	.614
Montana		995,912	112,467	.112
Nebraska ¹	2,483,372	1,879,143		
Utah		106,531	6,300	.059
Wyoming		1,969,945	80,841	.041

¹ Total receipts for biennium ending November 30, 1900, for interest, rentals, bonus, etc., were \$782,975.65.

In addition to these State rentals, the Union Pacific Railway in 1900 rented 428,800 acres in Wyoming and 667,520 acres in Colorado, and the Northern Pacific Railway leased over 1,000,000 acres at rentals varying from 2 to 7 cents per acre.

CONCLUSIONS REACHED.

During the past summer and preceding summers I have given much time to a personal investigation and study of the land and water problems of the West, and have reached the following conclusions regarding them:

(1) That private enterprise will have to be supplemented by public aid in the construction of certain classes of irrigation works if we are to secure the largest development of Western agriculture.

(2) That reservoirs located in the channels of running streams should be public works.

(3) That the first step toward national aid for irrigation should be the passage of enlightened codes of water laws by the States to be benefited.

(4) That the land laws should be modified by repealing the Desert Act and by requiring cultivation as well as residence on a homestead.

(5) That the nonirrigable grazing lands should be leased in small tracts so as to unite the irrigable and the pasture lands.

DIVISION OF ENTOMOLOGY.

The principal work accomplished by the Division of Entomology during the fiscal year ended June 30, 1901, is as follows:

ESTABLISHMENT OF SMYRNA FIG GROWING.

The practical completion of the investigations which resulted in the introduction and establishment in California of the fig-fertilizing insect (*Blastophaga grossorum*). An assistant was sent to Fresno in 1900, remaining there throughout the season, making observations which completed the life history of the insect and resulted in the ascertaining of important facts previously unknown, although in southern Europe the insect had been known and studied for very many years. He also took active part in the practical work of handling the insect and fertilizing the crop. Eleven tons of Smyrna figs were raised, dried, and placed on the market, and tests made by chemists and fruit experts show these figs to be superior to the imported product. The insects were successfully carried through the winter of 1900-1901, many of them hibernating successfully without cover; and, although not coming under the head of the fiscal year in question, it may be interesting to add that in the autumn of 1901 the crop of Smyrna figs was so abundant as to be difficult to estimate. Certainly more than 50 tons were gathered, and the full crop may possibly have reached as high as 75 tons. The fertilizing insect has been thoroughly established at several other points than Fresno, and the Division of Entomology now holds itself in readiness to see that a supply of the fig insects is furnished to any fig grower after he has succeeded in raising to the bearing stage caprifig trees and Smyrna fig trees.

WORK AGAINST THE SAN JOSE SCALE.

Several predatory insects have been imported from different foreign countries, and good results to American agriculture are expected. The most important of these will doubtless prove to be an enemy of the San Jose scale, which has been brought over from China.

Ever since the appearance of the San Jose scale in the United States the question of its original home has been a mooted one; and, since none of the parasitic and predatory insects of this country seem to be very efficient in destroying this scale, it has become an important point to decide, if possible, the question of the original home of the destructive insect, since it is quite fair to suppose that if efficient parasites are to be found they will be found in the original home of the scale. The importance of this quest can hardly be overestimated, since the damage which the San Jose scale has done to the fruit-growing interests of the country, especially of the Eastern States, is almost beyond estimate.

The evidence accumulating during the past two or three years had seemed to show that very possibly this scale was originally imported into this country from Japan, and in the spring of the present year the assistant entomologist, Mr. Marlatt, was sent to Japan for the purpose of studying the question on the ground. Unexpectedly to most entomologists, although not to the entomological force of the Department of Agriculture, it was quite definitely ascertained that the San Jose scale is not indigenous to Japan, but that, quite to the contrary, it was introduced into that country from the United States upon fruit stock at several different times and at several different points. The most careful search failed to reveal the scale in portions of Japan where American plants had not been introduced. Mr. Marlatt's travels in the Japanese Empire lasted about five months, and having satisfied himself, as just stated, he proceeded to China, visiting Chefoo, the port of the great foreign fruit district of North China, where the industry was started by a missionary (Dr. Nevins) some thirty years ago, since which time it has extended over the province. Foreign fruits were introduced and are now grown alongside the native fruits or grafted on native trunks. The San Jose scale was found there, but the admixture of foreign trees with the native trees prevented any conclusion as to whether the scale was indigenous or not. Proceeding to Pekin, he found the fruit markets enormously stocked and representing exclusively the products of the surrounding country and districts south of and adjacent to the Great Wall. All the fruits were native. The apples were small, and the pears were hard and woody. Nearly all this fruit was infested by the San Jose scale.

At Tientsin the same conditions were found in the fruit markets, and in the city gardens and private yards the San Jose scale was found on a flowering shrub coming from North China. In all the region between Tientsin and Pekin and the Chinese wall native fruits only are grown, and no foreign stock of any kind has ever been introduced. Apples, pears, peaches, apricots, and plums are extensively grown on the sunny slopes of all the hills south of the Great Wall. The San

Jose scale in this district could not have come from any foreign country, as there have been no importations and the fruits are all of native sorts. The scale occurs very scatteringly, although generally, just as it should if native, and is in a state of balance with its native natural enemies. It has a natural enemy, everywhere present and efficient, in a ladybird beetle known as *Chilocorus similis*. From this evidence Mr. Marlatt concludes without doubt that the San Jose scale is a native of North China. He has collected many specimens of this efficient natural enemy and has forwarded them to Washington. Steps will be taken to establish and acclimatize this important species, and it is hoped that it will prove as efficient against the San Jose scale in this country as it has in its native home. It is not beyond the bounds of probability that this importation will prove to be one of extreme value to the fruit growers of the United States.

BLACK SCALE, PLANT LICE, AND GRASSHOPPERS.

Possibly the next most important of these beneficial insects which have been introduced is a caterpillar enemy of the black scale, which has been brought over in healthy living condition from Italy by the assistance of Prof. Antonio Berlese, of the Royal School of Agricultural Entomology at Portici. The black scale is a serious enemy to olive culture in California. It occurs not only upon the olive but also less abundantly upon citrus trees, upon a shade tree known as the pepper tree, and other plants. It is the greatest drawback to olive culture in this country. The caterpillar in question (*Erastria scitula*) is found in Mediterranean regions, and is probably one of the principal causes of the comparative freedom of olive trees from black scale in that part of the world. The Division of Entomology has for eight years been attempting to bring this insect to the United States in living condition, and success for the first time was reached in November, 1901. This beneficial insect will be established in California with the assistance of the State board of horticulture of that State. It should be stated that the black scale is apparently a native of the general region from which this beneficial insect has been sent.

Another importation which may also prove to be an important one is a ladybird beetle, known as *Coccinella septempunctata*, which has been brought over from Hungary with the assistance of Prof. Charles Sajo. This insect, native to Europe, feeds upon several destructive plant lice which have been accidentally imported into this country from Europe, and upon the larvæ of the destructive asparagus beetles.

A fungus disease of grasshoppers has been imported from South Africa and has been experimentally used in different places in the United States through the summers of 1900-1901. In some localities it appears to have taken hold successfully, but it is too early as yet to predict any general success.

WORK OF LESS IMMEDIATE IMPORTANCE.

The other work may be summarized as follows: Studies of the insects affecting the violet, rose, and other ornamental plants have been completed. Extensive work has been carried on in regard to scale insects and experimental work with remedies has been conducted. The subject of the investigation of insects as carriers of diseases of human beings has been carried on, and much attention has been given to mosquitoes and house flies in this connection.

In cooperation with the Bureau of Soils, some work has been done looking toward the reclamation of brackish marshes which are breeding places of mosquitoes, and the studies of flies have indicated not only the importance of these creatures in the carriage of internal diseases, such as typhoid fever, but have indicated the cheapest and best remedies. Observations on insects affecting forest trees have been carried on during the year, and extended studies have been made of the codling-moth problem in the Northwest and of the Mexican cotton-boll weevil of Texas, information being obtained in both cases which promises practical results of very considerable importance. Extended studies were made during the summer of 1900 of the insects affecting citrus trees and fruits in southern California and a practical article detailing results was published in the Yearbook for that year. Experiments with remedies were conducted that included a series of experiments with washes against the scale insects and with fumigants both against scale insects and in storehouses, granaries, and tobacco establishments. An investigation has been made of a supposed insect damage to the cocoa-palm industry in Cuba. In apiculture comparative tests have been made of different races of bees and of methods employed in rearing queen bees.

WORK OF 1902.

Work for the fiscal year 1902 is already well under way. The investigation of the codling moth in the Northwest, as authorized by Congress, and of the Mexican cotton-boll weevil in Texas, also authorized by Congress, will be carried on through the whole year. The South African grasshopper fungus will receive further severe practical tests. Search for the original home of the San Jose scale will be continued. Advisory work with regard to the extermination of breeding places of mosquitoes will be continued, as well as many minor lines of inquiry.

OFFICE OF PUBLIC ROAD INQUIRIES.

OBJECT OF THE WORK.

In the establishment and maintenance of this Office the object has been to promote the improvement of the public roads throughout the United States. With that end in view, efforts were first directed to

ascertaining the condition of the roads, the state of public opinion in regard to their improvement, the obstacles in the way, and the best means and methods to be employed in securing better highways. Efforts were next directed to furnishing information in order that the people might be educated on this question, and to arousing interest and forming public opinion in order that practical results might be secured. Work along all these general lines has been continued up to the present.

PUBLICATIONS.

For several years after this Office was created its principal work consisted in collecting, publishing, and distributing information. This was embodied in a series of bulletins and circulars covering almost every phase of the road question. Of these publications hundreds of thousands of copies have been distributed. Some of them have been reprinted several times, and nearly all of them are still available for distribution.

The literary branch of the Office's work is still receiving careful attention, but it is no longer the principal line of work, greater attention now being devoted to educational work of a more concrete and extremely practical character.

OBJECT-LESSON ROADS.

For spreading information and arousing interest, there is nothing equal to the practical object lesson. The Office of Public Road Inquiries has been trying to show the people the best in the good-roads line.

During the past year "object-lesson" or "sample" roads have been built in nine States. While these have not been built at the expense of the Government, nor on the initiative of the Office of Public Road Inquiries, they are the fruits of its efforts. The Office simply accepts invitations from organizations and communities to give cooperation and technical advice in the making of these sample roads.

Work of this kind produces excellent results. The demand for its extension is far greater than the Office, with its present force and means, can meet.

In the building of sample roads heretofore the machines have been loaned by manufacturers, and the railroad companies have carried them free of charge. The local community has furnished the labor and material, and the Office of Public Road Inquiries has given expert advice and supervision. The Government could, at comparatively small expense, purchase the machinery necessary for continuing and extending this work, and it seems appropriate that it should do so, thus putting this very important branch of the work on a firmer foundation.

ROAD MATERIAL LABORATORY.

The laboratory for testing the chemical and physical properties of road materials, operated with the collaboration of the Bureau of Chemistry, has been in successful operation during the year. By determining in advance the character and suitability of the material to be used in a road, this laboratory saves taxpayers the loss and discouragement resulting from mistakes in selecting materials. This work is important and practical. It will be continued and if possible enlarged.

OTHER PRACTICAL WORK.

The dividing of the United States into four divisions, with a special agent appointed for work in each, has proved advantageous. The work done by these special agents consists principally in the study of conditions, the delivery of lectures, correspondence, and preparation of matter for publication. In the Eastern Division no field work has been done because the special agent assigned to that work was placed in charge of the road-material laboratory. In the other divisions—Middle, Western, and Southern—much better results might have been secured if the Department could have kept these special agents employed all the time. This was impossible owing to the inadequateness of the sum—only \$1,500 for each division—available for the payment of all expenses.

A great amount of valuable field work has been done by the Director and his assistants during the year. They have traveled thousands of miles, attended conventions, delivered lectures, and directed the building of sample roads. Their work has reached into 23 States.

The work of this Office is of great and growing importance. Popular appreciation of its efforts has greatly increased, as shown by press comments and resolutions adopted by many popular gatherings. The demand for the services of the Director and his assistants far exceeds the limits of their time and energy. There is an unmistakable popular demand that the Office of Public Road Inquiries be given a largely increased appropriation, a demand with which I am in hearty sympathy. If a larger sum should be appropriated for this purpose I believe it would be profitably expended in carrying on and extending the work of this Office.

DIVISION OF PUBLICATIONS.

In the performance of its duty to diffuse the information acquired through its several Bureaus, Divisions, and Offices the Department depends mainly upon the issue and distribution of publications. The work of the Division of Publications affords, therefore, a fair reflex of the activity and intelligence characterizing the investigating

branches of the Department, and for this reason it is important to observe that the extent of the work devolving upon it is dependent entirely upon agencies outside of the Division and beyond the control of its chief.

It is obvious, therefore, that every step taken in the development and extension of the work of the Department increases the work of the Division of Publications, and yet it must be admitted that the provisions made for the publication work and the distribution of the Department publications have never been fully adequate to the task imposed upon it. The result has been, unfortunately, that every year important reports have been withheld from publication, either until a new fiscal year has brought with it new appropriations, or until a resolution could be passed by Congress specially authorizing their publication and assuming the cost thereof. It is of the highest importance that our publications should be timely and that the practical results of investigations made—all useful information, in fact, acquired by the Department—should be promptly given to the public. These delays are not infrequently costly and are at all times vexatious. Again, in the matter of distribution, the distributing force, largely underpaid as it is, is frequently disorganized and demoralized by suspensions and furloughs necessitated by want of funds, to say nothing of grievous hardship thus imposed upon many hard-working and faithful employees. Not less than 35 persons suffered in this way last year, in spite of the fact that \$5,500 of this year's appropriation was made immediately available, and it has become necessary again this year not only to ask for a very considerable increase in the force but to have a considerable sum again made immediately available in order to carry on the work efficiently to the close of the present fiscal year.

GROWTH OF THE PUBLICATION WORK.

In spite of the restrictions thus imposed upon the work of publication, it has nevertheless grown wonderfully during the past ten years. In 1893 there were issued from the Department 210 publications, aggregating over 2,500,000 copies. In the year under consideration, 1901, there were issued 606 publications, aggregating nearly 8,000,000 copies.

FARMERS' BULLETINS.

Of the above publications 3,345,000 copies were Farmers' Bulletins, of which 2,200,000, in round numbers, were distributed under Congressional orders. The total number of Congressional quotas drawn was 413. With the accumulated copies due to quotas undrawn and the increased appropriation for the Farmers' Bulletins the quota for each Senator, Representative, and Delegate for the current year has been fixed at 15,000 copies. Under the present law four-fifths

instead of two-thirds of all copies printed are available for Congressional use, and to satisfy both the Congressional and the Departmental requirements will necessitate an issue of Farmers' Bulletins aggregating a number of copies almost equal to the entire output of all publications of the past year. It has been necessary, to meet this greatly increased demand on our resources, to lease a building in the vicinity of the Department to be exclusively devoted to the storage and shipment of Farmers' Bulletins. This makes the fourth building occupied, in whole or in part, by the Division of Publications.

RELATIVE COST OF EDITORIAL WORK.

It is proper to call attention to the fact that in proportion to the total output of publications and the amount expended for actual printing, the expenses of editing, illustrating, and distributing the publications, and of the clerical work involved in the disposal of the immense mass of correspondence devolving upon this Division, as the result of the nearly 300,000 applications for publications received during the year, amount to very much less proportionately than was the case ten years ago. In fact, at no time since the Division was organized has the cost of editing, illustrating, distributing, and of the clerical work been so small in proportion to the actual cost of printing and the number of publications distributed.

THE YEARBOOK.

The Yearbook of the Department continues to be in great demand. It is difficult to keep it within the limits of a convenient book, owing to the immense variety of subjects covered by the work of the Department, which should be represented in it; also owing to the mass of important information, statistical and otherwise, which finds a place in the Appendix, and which, as far as I know, is not available elsewhere. Under these circumstances the propriety of issuing the Yearbook in two volumes, the first to consist of independent articles contributed by the various bureaus, divisions and offices, and the second of the Appendix, presents itself as worthy of consideration.

The Department is subjected to great inconvenience by the smallness of the number of copies of the Yearbook placed at the disposal of the Secretary, and a more liberal allowance is urgently needed to supply the demands for this publication. When the total number of copies of the Yearbook issued was but 300,000, and when the work of the Department was not one-fourth of what it now is, 30,000 copies were allowed the head of the Department, then Commissioner of Agriculture. To-day, with 500,000 copies issued yearly, the same number, 30,000 copies, is placed at the disposal of the Secretary. Fifty thousand copies, at least, are required for the needs of the Department.

SALE OF DEPARTMENT PUBLICATIONS.

Through the courtesy of the Superintendent of Documents of the Office of the Public Printer I am able to present a report of the sale of Government publications, which shows a very large and increasing demand for the publications of this Department, even when the same have to be paid for. This fact suggests the possible—I might almost say probable—solution of the great difficulty which now attends our efforts to achieve an effectual and equitable distribution of our publications. The following table shows the number of Government publications sold and the amounts received therefor during the past four years:

Number of publications sold and amount received.

Department.	Publications sold.				Amount received.			
	1901.	1900.	1899.	1898.	1901.	1900.	1899.	1898.
Department of Agriculture	24,127	16,905	18,750	17,740	\$3,220.25	\$2,157.65	\$2,154.45	\$2,089.15
All other Departments ..	9,458	10,928	8,058	3,623	6,862.44	6,744.56	5,401.66	2,448.12
Total	33,585	27,903	26,808	21,363	10,082.69	8,902.21	7,556.11	4,537.27

IMPROVEMENT OF ILLUSTRATIONS.

In the enforced economy in our publication work, owing to the limited funds at our disposal, the work of illustration has unduly suffered. It has been treated more as a nonessential in a publication, however desirable it might be. In connection with the work of this Department, illustrations, though not always essential, are in many cases, when properly conceived and executed, extremely useful. The rule laid down in this branch of the work is to exclude merely ornamental pictures, and to confine illustrations to such as are desirable and calculated to facilitate the reader's apprehension of the text. It is also of the first importance that such illustrations should be the best of their kind. It has not been possible for the last two years to fulfill either of these conditions, and I have deemed it desirable to include in the appropriations for next year a special sum sufficient to pay the necessary force of artists and draftsmen, and to provide for a certain amount of illustration work over and above what we can afford to include in the regular printing fund.

NEED OF ENLARGED QUARTERS.

The urgent need of a new building is nowhere more forcibly exemplified than in the objectionable conditions under which it is necessary to carry on the work of this Division. Crowded and inadequate quarters assigned to the Division here and there—some on the main floor and some in the attic of the main building, others in widely separated

and for the most part unsuitable buildings—grievously hamper the work of the 140 persons necessarily employed in the editing, illustration, and distributing of publications, and in the correspondence and clerical work entailed thereby.

SECTION OF FOREIGN MARKETS.

Agriculture contributed conspicuously to the remarkable expansion of American commerce witnessed during the past year. According to statistics prepared by the Section of Foreign Markets, the highest record previously attained in the exportation of agricultural products from the United States, that for 1898, was surpassed by more than \$90,000,000 in the fiscal year ended June 30, 1901, when a value of over \$950,000,000 was reached. Fully 65 per cent of the domestic merchandise sent abroad during the year originated on the farm.

EUROPEAN MARKETS.

Among our foreign customers in agricultural products the United Kingdom stands preeminent, taking over 50 per cent of our exports. Recent investigations by this Section into the possibility of still further increasing our trade in the British market brought out the significant fact that during the calendar year 1900 our agricultural exports to the United Kingdom, large as they were, comprised only 33 per cent of the foreign farm produce purchased by that country, leaving two-thirds of such produce to be supplied by our competitors.

In view of this fact, the desirability of procuring exact information as to the character of the agricultural imports received by the United Kingdom from countries other than the United States was apparent. The Section has accordingly begun the preparation of a comprehensive report on the subject. It will be the special object of this report to suggest such opportunities as exist for extending our trade in the British market in competition with other countries that are now conducting a lucrative business there.

After the United Kingdom the most important foreign markets for our surplus farm products are afforded by Germany, France, the Netherlands, and Belgium. During 1901, Germany received 15 per cent of our exports, and France, the Netherlands, and Belgium together about the same amount. Each of these countries like the United Kingdom is at present importing extensively from other sources. They therefore offer similar opportunities for more active competition on the part of the United States. Reports on the agricultural imports of these countries have also been planned.

TRADE WITH DEPENDENCIES.

Special statistics have been compiled by the Section relative to our trade in farm products with the new insular dependencies, except

Hawaii, for which no separate returns are now made. Our agricultural exports to Cuba, Porto Rico, and the Philippine Islands in 1901 were valued at \$18,600,000, comprising about 53 per cent of the domestic merchandise sent to those destinations. Compared with the trade for 1900, amounting to \$17,551,000, the returns for 1901 exhibit a slight increase, gains in the exports to Porto Rico and the Philippines more than counterbalancing a considerable decline in the exports to Cuba.

As regards our agricultural imports from the three dependencies under consideration—Cuba, Porto Rico, and the Philippines—there was a decided increase, the value for 1901 amounting to \$48,600,000, as compared with only \$36,162,000 for 1900. The bulk of the gain occurred in the imports from Cuba, but there was also a noticeable increase in the case of Porto Rico. The imports from the Philippines showed a decline.

TRADE OF PACIFIC PORTS.

During the year the Chief of the Section of Foreign Markets was detailed to accompany the Congressional Committee on Rivers and Harbors upon its tour of inspection to the ports and waterways of the Pacific coast. The trip afforded an excellent opportunity to study the growing export trade that is being conducted through our Pacific ports, and much valuable statistical information was gathered on the subject. Of the \$70,000,000 worth of domestic merchandise exported from the Pacific coast during the fiscal year 1900, \$45,000,000 worth, or considerably more than half, consisted of farm produce. Indications point to a still further increase during the immediate future, the opening of new markets in the Orient and the rapid development of the wonderful agricultural resources of the Pacific coast region combining to render this branch of our commerce one of the most promising.

LIBRARY.

ACCESSIONS TO THE LIBRARY.

During the past year the accessions to the Library have numbered over 4,000 books and pamphlets. These accessions included many reference books of especial value in the work of the Department and a large number of scientific periodicals. The latter class of publications, obtained by purchase and by exchange, forms the most considerable, as well as the most valuable, part of the annual accessions.

CATALOGUE.

In addition to the regular work on the general card catalogue, a "Catalogue of periodicals and other serial publications" contained in

the Department Library has been completed and will be issued at an early date. Two reference lists, one containing references to publications on irrigation and land drainage and the other on tobacco, have been prepared, but a lack of funds for printing delays their publication as Library bulletins. It is to be regretted that the printing appropriation has not been sufficient also to provide for an increased number of issues of the card index to the Department publications. This index has increased the usefulness of these documents many fold.

DEMANDS UPON THE LIBRARY.

The constantly broadening fields of investigation being entered upon by the Department increase greatly the demands upon the Library. These investigations depend largely upon the extent of the Library's resources and their availability. To further these conditions adequate appropriations are needed, both for books and for their care and preservation. The amount of reference work done in the Library has increased so much during the past year that an assistant for this special work is much needed.

ASSISTANCE TO AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

In not a few cases college and station workers have drawn upon the resources of the Library to assist in some special work. Whenever it can be done without interference with the work of the Department, the usefulness of this large collection of books and pamphlets, many of which are not to be found elsewhere in this country, should be thus extended. This Library may justly claim to be the headquarters for agricultural literature, and as such should be able and ready to meet the demands from without as well as from within the Department. The requests which come from colleges and station libraries for suggestions as to the best arrangement of their material and as to other details of administration should be met with a ready response.

NEED OF MORE SUITABLE ACCOMMODATIONS.

The present Library room is entirely inadequate for the accommodation of readers and for the work of the Library staff. Much space is occupied for other than library purposes on account of the generally crowded condition of the Department offices. In addition to the necessity for more commodious accommodations for the present collection of over 70,000 books and pamphlets, there is the still greater need of a safer building than the one in which the Library now is. The destruction of any considerable part of this valuable collection of books would be an inestimable loss to the Department in particular and to scientists at large.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Congress appropriated \$3,303,500 for the United States Department of Agriculture for the fiscal year ended June 30, 1901, being an increase of \$558,920 over the appropriation for the preceding year. When all accounts shall have been finally settled the payments will amount to about \$3,220,000.

The regular appropriation of \$15,000 for each of the 48 agricultural experiment stations in the several States was also made.

On June 30, 1901, the unexpended balances of the appropriations for the year 1899, amounting to \$28,899.27, were covered into the Treasury.

During the year \$6,340 was paid for rental of leased buildings in Washington. Owing to inadequate accommodations Congress, at its last session, provided for the lease of additional buildings, and the rental for the fiscal year 1902 will exceed \$10,000.

BIOLOGICAL SURVEY.

The Biological Survey is engaged in mapping the boundaries of the natural crop belts of the country and aims to furnish the American farmer with lists of agricultural products which, so far as climatic conditions go, are likely to be a commercial success in different parts of the country. This work is based on the theory, the correctness of which is believed to have been established by the Biological Survey, that the boundaries set by nature to areas inhabited by particular kinds of native animals and plants are likewise the boundaries of areas in which particular agricultural crops may be most successfully cultivated.

LIFE ZONES AND CROP BELTS IN TEXAS AND CALIFORNIA.

During the past season the work of mapping the life zones and crop belts in the West has been continued, particularly in Texas and California. In Texas the boundaries of the several belts have been in the main determined, and it has been ascertained that over a large part of the arid lower Sonoran zone a fiber plant, a species of agave closely related to the Mexican istle or "Tampico hemp," grows in great abundance, covering an area about 20,000 square miles in extent. In view of the enormous quantity of fiber of other species of agave annually imported into the United States, mainly from Mexico, amounting in 1900 to 82,669 tons, worth \$12,257,353, the Texas species is likely to prove of considerable commercial value.

In locating the boundaries of the zones in California many interesting facts have been brought to light. In this State, owing to the trend of the mountains and the influence of the coast fogs, the zones run in the

main north and south instead of east and west; and, except in the coast region and the northern part of the State, all but one are pushed up into the mountains. The valleys of the coast ranges, in retreating from the sea toward the interior, receive less and less fog and more and more heat and sunshine, affording in their individual climatic peculiarities conditions favorable for the growth of widely different agricultural and horticultural crops. Thus, while some are cool enough for apples, cherries, and the sugar beet, others are warm enough for almonds, citrus fruits, and raisin grapes. The hottest parts of the State, as well known, lie in the deserts east of the mountains, where, through the instrumentality of this Department, the date palm seems destined to become an important and profitable crop.

DESTRUCTION OF PRAIRIE DOGS.

On our great plains, which stretch from Montana and the Dakotas southward far into Texas, one of the chief enemies to agriculture and stock raising is a large ground squirrel known as the prairie dog. This animal appears to be increasing rapidly, owing to the destruction of its natural enemies, chiefly coyotes, badgers, ferrets, hawks, owls, and eagles. It is destructive not only to grain, alfalfa, and other cultivated crops, but also to the native bunch grass; and ranchmen complain that on certain grazing lands over which its colonies have spread during the past few years its mounds are so numerous and its consumption of herbage is so great that only half as many cattle can be pastured as formerly. In response to persistent complaints and urgent requests for remedies, the Biological Survey has prepared and distributed a circular of directions for the destruction of prairie dogs, and is now conducting field experiments in the Dakotas, Nebraska, Kansas, and Texas with a view to the discovery of remedial measures cheap enough for general use on the ranch lands of the plains.

SOME USEFUL AND NOXIOUS BIRDS.

In southern California it has been discovered that two species of birds, the Bullock oriole and the California least tit, feed extensively on the destructive olive scale, an insect injurious to both olive and orange trees, and that the common Western goldfinch feeds on green plant lice. On the other hand, some birds, particularly the house finch or "linnet," are bitterly complained of as enemies of the fruit grower. The relations of birds to fruit culture in California are so important that the assistant in charge of this subject was sent to the principal fruit-growing areas of the State, where important investigations were made, the results of which are now being prepared for publication.

In Texas it has been found that the large blackbirds, locally known

as "jackdaws," which have been slaughtered in great numbers for the millinery trade, are particularly valuable in the rice fields and cabbage growing districts, feeding extensively on the crayfish, which eat the rice, and on the destructive cabbage worm. In other investigations of the food habits of birds special attention has been given the thrushes, titmice, sparrows, orioles, woodpeckers, flycatchers, and swallows. The growing interest in economic ornithology is shown by the rapidly increasing demand for literature on this subject, to partly meet which a number of bulletins on food habits of birds have been published and distributed. The edition of one of these, entitled "Some common birds in relation to agriculture," has already reached 220,000 copies.

WORK UNDER THE LACEY ACT.

In addition to its other duties the Biological Survey is charged with general supervision of matters relating to game protection and introduction. It publishes bulletins on this subject and on laws governing the transportation and sale of game, digests of State game laws, and so on, and aids in every way possible the preservation of native birds and game. In carrying out the provisions of the Lacey Act the Department has received the active cooperation of three other Executive Departments—Treasury, Interior, and Justice; of several railroad and express companies; and of many State officials and individuals. A system of permits for the importation of foreign wild animals and birds has been successfully put into operation, and provision made for inspection at six of the most important ports of entry. During the year the number of permits issued was 186, covering the entry of about 350 mammals and nearly 10,000 birds. In order to avoid undue annoyance to importers I have extended the list of species which can be imported without permits to include a number of well-known animals intended for exhibition purposes. It is gratifying to state that the law has accomplished its main purpose in preventing the introduction of the mongoose and other injurious species, and has also brought to light several facts of interest. A considerable trade in live pheasants is carried on with Canada; thousands of Chinese quail are imported alive at San Francisco; and cage birds of many species are imported from Germany, China, Japan, Australia, and Mexico. The danger of introducing injurious species is very great, since several thousand birds are frequently imported in a single consignment; protection lies in careful inspection at the port of entry. During the coming year the inspection service will not only be improved but will be extended to Hawaii. Provision should be made for placing this service on a permanent basis and for maintaining it in the most efficient manner.

INTERSTATE COMMERCE IN GAME.

Numerous violations of the law regulating interstate commerce in game have been reported, and in many instances the Department has

been called upon to assist in prosecuting the offenders. Fifty-seven cases have been investigated, of which 27 have been referred for action to the Department of Justice, but whenever possible the evidence has been placed in the hands of State authorities. For the first time in the history of game protection it has been possible to secure convictions in cases involving illegal shipment of game months after the offenses were committed, and with evidence obtained a thousand miles or more from the point of shipment.

NEED OF MORE LIBERAL APPROPRIATION.

Again it seems necessary to call attention to the insufficient appropriation by reason of which the Biological Survey is obliged to carry on its field work in a piecemeal way, doing a little each season and returning the next year to the same region. The work could be done for considerably less money if the survey of a particular area could be completed at one time. A special effort has been made to carry the prairie dog investigation to a successful conclusion, but this requires field work on the Great Plains in the early spring, for which no funds are available. Owing to the same cause the Biological Survey has been forced to decline requests from several States for cooperation in carrying on local biological surveys. Such cooperative surveys would hasten the completion of the zone and crop maps, and would be of material service both to the States interested and to the General Government.

DIVISION OF STATISTICS.

With a smaller appropriation available for its work than was expended for a like purpose in any fiscal year from 1891 to 1898, inclusive, the Division of Statistics has endeavored to meet the ever-growing demand for statistics of the agricultural industry. It handled during the fiscal year nearly 2,500,000 returns from a corps of correspondents numbering about 250,000, the results of its work appearing in 18 separate reports, of which over 1,500,000 copies were printed.

While its work has consisted largely, as heretofore, of the preparation of reports relative to the principal products of the soil, including the extent and geographical distribution of the area of production, the condition and prospects of the crop during the growing season, and the quantity, quality, and disposition of the product harvested, it has also included reports on other branches of rural economics, such as the cost of transportation, the prices of agricultural products, the wages of farm labor, and the extent to which the principle of cooperation has been applied to different branches of the agricultural industry.

There is an urgent demand from many different directions for a substantial broadening of the scope of the work of this Division. Only the insufficiency of the appropriation prevents the live stock and live-stock products of the country—an interest so enormous that after sat-

isfying the needs of our own large population there was available last year for export over \$250,000,000 worth of its products—from being reported upon as promptly and fully as are the cotton, corn, and wheat crops of the country. The annual fruit crop, the egg and poultry industry, beet sugar, flaxseed, and other products of great and growing importance also claim attention. The Department has already in operation all the agencies necessary to the collection, as often as may be necessary, of the required information relative to these important interests, and all that remains to be done is to provide the means for the employment of such additional experts and statistical compilers as may be necessary to the prompt compilation and analysis of so large an amount of additional statistical data.

Negotiations with the Governments of the principal grain-producing countries of Europe looking to a telegraphic interchange of crop reports are far advanced, and the growing season of 1902 will see the American farmer placed in as prompt possession of reliable statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

For several years past determined efforts have been made, with the cooperation of the Public Printer, to expedite the publication and distribution of the Statistician's crop reports, so that as little time as possible might intervene between the issue of the telegraphic summary, the circulation of which is necessarily chiefly commercial, and the receipt in the most remote agricultural county of the complete report. On May 31, 1901, however, at a time when the keenest interest was prevailing throughout the entire South as to the extent of the newly planted acreage of cotton, a card containing the most important points of the Statistician's report on the subject was mailed to 24,000 Southern post offices within three hours of the publication of the telegraphic summary, with a request that postmasters would give it prominent display in their offices. This was done largely as an experiment, and so successful was it that within a few weeks its operation was extended with the most gratifying results to the grain reports. A farmer has now only to visit the nearest post-office to see the Statistician's latest report on the principal crops, and the measures adopted by the Public Printer and Postmaster-General have reduced to a minimum the time necessary to placing this important information within the farmer's immediate reach.

The remarkable accuracy of the Statistician's advance estimates of the cotton crop in each of the last two years has excited much favorable comment both in the United States and abroad, and his work in general is commended to Congress as worthy of largely increased provision for its further extension and improvement. This Division is growing in usefulness and in the estimation of the people. It is outgrowing its present environment and it will be wise in the near future to give it bureau enlargement.

SALARIES INADEQUATE.

During the remarkable developments in the agriculture and commerce of this country within the past fifteen or twenty years, the Department of Agriculture has steadily improved its personnel, has broadened its work along economic lines, and has contributed not a little to the progress of events and to the building up of domestic and foreign trade. Originally organized as a scientific bureau for acquiring and disseminating among the people useful information, it has solved many problems in animal industry concerning the cause and remedy of disease, has stamped out contagious diseases which threatened to ravage the country, and has kept open foreign markets by its system of rigid and competent inspection; through the Weather Bureau it has aided in saving growing crops and the products of the farm in transit, besides being of inestimable value in its warnings for the benefit of commerce in lake and ocean navigation. It has investigated the proper methods of controlling plant diseases and insect pests. It has studied and classified soils, pointing out their necessities and their values for certain crops, and has introduced new crops and new industries from abroad.

The Department has endeavored to retain the best scientific talent in the country for the investigation of the many problems confronting the agriculturist, in the interest not of pure science but of agricultural and commercial development. Coincident with the growth in the Department's duties, and largely as an outcome of it, numerous institutions have grown up in every State of this country, as well as in foreign lands, devoted to lines of work similar to those pursued in the Department, which may be generally described as the application of science to the service of agriculture. These State and governmental institutions, and the private agricultural interests as well, are now paying salaries for expert services commensurate with those paid in professional and industrial lines. Men with good business training and thorough understanding of agriculture and a fair knowledge of scientific principles and methods are constantly in demand at good prices.

There has never been in the history of the world such a strenuous competition between the different countries for commercial supremacy as exists to-day. Each nation is exerting itself to the utmost to extend its production, so as to supply its own wants and to provide a surplus for exportation. In doing this they are depending more and more upon the aid of science, and are taking advantage of every scientific discovery. The result is that men who combine knowledge with experience and practical ability are difficult to get and are increasingly in demand. In the general conflict between nations it is obvious that that country which has been the most liberal in securing properly equipped organizers of its industry is sure to have the advantage in this commercial strife.

Yet the Department of Agriculture of this country has frequently had to record the loss of men trained in its services, who have been called away to other fields by offers of more generous remuneration. The danger of losing good men has never been so great as at the present time. Last year a foreign government secured one of our tobacco experts at a salary four times what this Department was giving him, and quite recently the papers have announced that the result of investigations made under his auspices are so promising that it is believed the demand for American and other imported tobaccos in that market can be stopped and the requirements supplied by home production. Subsequently an offer was made to another tobacco expert in the employ of this Department at a salary of about three times what he was being paid. This had to be met by an increase in his salary, amounting to one-third more than the chief of the division who was directing the work was allowed by statutory enactment. As an executive act, this was not good policy nor compatible with the best interests of the Department, but the work in hand had to be provided for, pending further action by Congress.

More recently still, advances have been made by several foreign governments to secure the services of some of the leading men of the Department, the chiefs of Bureaus, offering such liberal increases over the salaries paid here that it becomes almost a matter of duty on the part of the men to accept. Such acceptances, if carried out, would not only cost the Department some of its leading men, but would also draw away many of their subordinates who are now in excellent training for valuable work.

It is apparent in reviewing the work of the past fiscal year that the men who have planned and executed the investigations which have been carried on, have earned for the country many times over the cost of their salaries and the money appropriated for their use. It is an axiom among business men that the more expensive employees are often the cheapest, by reason of their being most productive. The Department has always been obliged to train its own men, and has only too frequently lost their services when, from their ability to handle large questions, they have been called elsewhere at more remunerative salaries. The Department should not always be in this position of having to train its men in order to get them cheaply, but should be allowed to secure the services of capable men already trained by giving salaries commensurate with the valuable commercial interests to be put in their charge. The loss of time necessary to train men to handle these problems is in itself a serious drawback, and if they are called elsewhere after receiving their training and before they give valuable returns to the Department in the way of productive work, the time and money spent upon their training is largely thrown away.

In view of these facts, I have provided in my estimates for a salary

of \$5,000 for the chiefs of the Bureaus in this Department, firmly believing that the men who now occupy these positions are fully deserving of such salaries; that if less is given them they will be called to other countries or to other positions in this country, and that if these men, who have been instrumental in the remarkable development in the work of the Department in recent years, sever their connection with the institution it will be impossible to fill their positions with capable men for anything less than the salaries named. I would urge upon Congress in the strongest terms liberality in this regard, as I believe it to be for the best interests of the country to obtain and retain the best men that can be found for these important positions; and I would also urge this increase in their salaries in order that we may appoint experts at salaries which they can command in commercial lines, and not have to take the humiliating step of paying the experts more than the chief of the bureau who is directing the work, a step which has had to be taken twice already in one of the Bureaus of this Department, in order to secure from the commercial world men competent to maintain the integrity and insure the success of the work that had been undertaken.

The chiefs must direct the special technical education of the students in their lines. If we could look to the universities and colleges of the country for men prepared to do our work in applied sciences relating to agriculture, the loss of an expert chief would not be so serious. From the agricultural colleges we are getting young men and women as scientific aids, who will become valuable investigators and teachers in their specialties after being trained in the Department, but the chiefs who train them are indispensable at present.

Respectfully submitted,

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 23, 1901.*

DEPARTMENTAL REPORTS.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, D. C., July 22, 1901.

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1901.

Respectfully,

WILLIS L. MOORE,
Chief of Weather Bureau.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

OCEAN FORECASTS AND INTERNATIONAL COOPERATION.

An important extension of the forecast work of the Bureau was made during the year. By an arrangement with the secretary of the meteorological office at London, England, the transmission by cable from London to Washington of meteorological reports from certain points in the British Isles and on the Continent of Europe, and from Ponta Delgada, Azores, was begun December 18, 1900. These reports, with observations from Nassau, Bermuda, and Turks Island, have been regularly published on the daily weather maps issued at Washington, Baltimore, Philadelphia, New York, and Boston, together with forecasts of the force and direction of the wind and the state of the weather for the first three days out of steamers bound east from American ports.

The Atlantic forecasts, which are based on the American, Atlantic, and European telegraphic reports, were begun January 7, 1901, and on June 1, 1901, they were made a part of the regular general night forecasts issued at Washington. In a number of instances, when storms of marked strength were passing eastward off the American coast, forecasts were issued of the character of the weather which would probably be experienced by steamers leaving European ports westward bound, and by an arrangement with Lloyd's, of London, these advices have been cabled to England.

In addition to the daily forecasts of wind and weather and special storm warnings, predictions of fog were issued when conditions favorable for fog development had been indicated in the steamer tracks west of the fiftieth meridian. Reports from trans-Atlantic steamships show that these forecasts and special warnings have been well verified.

In November, 1900, arrangements were made with Portugal to receive reports from the meteorological observatory at Horta, in the Azores. Observations are now regularly received by cable from that

place, and they are of much value in the work of forecasting the movements of storms on the Atlantic Ocean.

NEW FORECAST DISTRICTS.

Three additional forecasting districts have been established and designated as the New England district, the West Gulf district, and the Rocky Mountain district, with headquarters at Boston, New Orleans, and Denver, respectively. The last appropriation bill passed by Congress made provision for three additional forecast officials to be placed in charge of these districts with authority to issue forecasts and warnings for the several States that are comprised in each district. This system has the advantage of enabling each forecaster to devote more time to the consideration of the predictions for each district and of securing an earlier distribution of forecasts. As these forecast officials were selected on account of their ability as forecasters for their respective sections, it is expected that an improved service will result.

IMPROVEMENT IN FORECASTS.

Special consideration has been given to the subject of increasing the accuracy of the forecasts of the Weather Bureau to the highest degree attainable, and, as a means of stimulating among the employees of the Bureau the study of the problems of weather forecasting, announcement has been made that hereafter marked success in forecasting, the invention of new methods of forecasting, or the discovery of new facts or principles of marked value to the forecaster, will have a special weight when the merits of employees of whatever grade for promotion are considered.

The forecasters of the central office at Washington have been relieved, as far as possible, of all other routine work, and they will devote their whole time and energies to forecast duty. These forecasters, when not detailed at the daily work of forecasting, will engage in studies that aid them in their work. It is believed that this arrangement will result in an improvement of the forecasting work of the service.

CLIMATE AND CROP WORK.

The lines of work pursued in previous years by the climate and crop service of the Weather Bureau were continued, and extensions and improvements made wherever possible. The cotton-region service has been extended into Oklahoma and the Indian Territory, and arrangements have been made for inaugurating a similar work in California, to be known as the fruit and wheat service.

Few persons realize what a complete system the Weather Bureau forms for the accurate and rapid collection and dissemination of crop information. It has 1,200 paid and skillfully trained officials outside of Washington, who are quite evenly distributed over the United States and its island possessions, and who are available to report on any matters concerning weather, crops, climate, or statistics. It has 200 officials and employees at the central office in Washington. It has 180 fully equipped meteorological stations quite equidistantly scattered over the United States and its dependencies, each manned by from one to ten trained officials, which stations are not only weather observatories, but are centers for the gathering of statistical and climate and crop reports. It has a central observatory in each State and Territory,

to which all subordinate offices in the State report, and to which all voluntary weather and crop observers report. These central observatories are equipped with printers, printing plants, trained meteorologists and crop writers, clerks, and messengers.

The State central offices are under the systematic direction of the central office at Washington. The central office at Washington is equipped with cartographers, printers, pressmen, lithographers, and elaborate addressing and mailing appliances for the printing and mailing of large quantities of national weekly, monthly, quarterly, or annual reports and bulletins. The telegraph circuits of the Weather Bureau are ingeniously devised for the rapid collection, twice daily, of meteorological reports; they are also used to collect the weekly National crop bulletin. The Bureau has 315 paid temperature and rainfall reporters who are now daily telegraphing their data from the growing fields to certain cotton, corn, and wheat centers. It has 250 storm-warning displaymen distributed among the ports along the Atlantic, Gulf, and Pacific coasts and in the lake region. It has an observer serving each morning on the floor of each important board of trade, commercial association, or cotton or maritime exchange in the country, who displays weather and crop information, and each day charts the weather reports on a large map. It has 3,000 voluntary observers—nearly one for each county in the United States—equipped with standard thermometers, instrument shelters, and rain gauges, who have for years intelligently served the Government by taking daily weather observations and rendering weekly crop reports to State central offices. There are 14,000 persons reporting weekly to the climate and crop centers as to the effect of weather upon the crops in their respective localities. These voluntary crop correspondents could quickly be increased in number to several hundred thousand if occasion required. In four weeks there are printed and distributed 168 different State crop bulletins, four National crop bulletins, and 42 monthly eight-page State climate and crop bulletins. The weekly State crop bulletins are written by the directors of the different State sections, and the weekly National crop bulletin by Mr. James Berry, chief of the climate and crop division of the Weather Bureau, a man who has had many years experience as a writer on crop conditions in the United States.

FORECASTS BY RURAL FREE DELIVERY.

Particular attention has been given to the distribution of forecasts by means of the rural free delivery. There are now in operation 365 centers supplying an aggregate of nearly 42,000 families in the farming districts with the latest weather predictions. This work has become decidedly popular, and we have had the hearty cooperation of the Post-Office Department in making it a success.

Estimate has been made for additional appropriation with which to extend the distribution of forecasts and warnings by this method. The rural free delivery places the frost and cold-wave warnings in the hands of those who can make the most valuable use of them. It is expected that the Bureau will reach several hundred thousand farmhouses with the daily forecast before the expiration of the coming year.

MOUNTAIN SNOW BULLETINS.

The local snow bulletins that are issued by the State centers in the Rocky Mountain region are meeting a very important need. These

bulletins give complete information as to the depth and character of snowfall in the mountains—data that have such an important bearing on summer water supply for irrigation purposes.

ETHERIC SPACE TELEGRAPHY.

Substantial improvements have been made during the past year in the Weather Bureau system of wireless telegraphy. The line of research has been divided into three classes: First, the perfection of a more powerful transmitter, in which the energy of radiation shall be greatly increased; second, the devising of a more delicate receiver, one that would be positive instead of depending upon an imperfect and variable contact, as do all systems now in use; and, third, the perfection of a system of selective telegraphy whereby messages can be differentiated and only the receiver that it is desired shall receive the message become responsive to the waves of ether.

The first of these problems may be said to have been successfully solved, and a transmitter devised capable of radiating all the energy generated; the second is believed to be nearing a successful solution; the third is thought to be well demonstrated theoretically, but has not been fully tested in practice.

While there is much experimental work yet to be done before our system, or any system of which I have knowledge, is reliable for inter-ship communication, or before any two systems can work within the same field without each rendering the other useless, such progress has been made by the Government experimenters that, with no interference by private systems, stations can be successfully operated over at least 150 miles of coast line, and they are now in operation on the North Carolina and Virginia coasts, and soon will be instituted between the Farallone Islands and the mainland, and Tatoosh Island and the mainland, on the Pacific coast.

If a system of selective telegraphy can not be perfected so that one system does not interfere with and render useless another, and thereby prevent all use to commerce of recent discoveries in wireless telegraphy, it may become necessary, on account of the value of these discoveries to our marine interests, for the Government to take exclusive control of all systems of etheric space telegraphy and to establish stations along our extensive coast lines at such distances and in such relation, the one to the other, that they shall not interfere. Even then there will occasionally be difficulty in communicating with the mainland whenever two ships in close proximity are attempting to transmit or receive messages at the same time.

DESTRUCTION OF HAILSTORMS WITH CANNON.

Considerable interest has been aroused among agriculturists in the United States relative to the prevention of hailstorms by the use of explosives fired from specially designed cannon. The experiments conducted along this line by grape growers of France and Italy have aroused popular interest in this country. The theory is not a new one, though perhaps not so ancient as the idea that precipitation occurs soon after and as a result of the explosives used in battles. As early as 1769 the Marquis de Cheviers, a retired naval officer of France, thought that he could combat the scourge of hailstorms by the firing of cannon, but his experiments, like those conducted by many others at various times during the past century, were not productive of definite results.

One of the most serious drawbacks to grape culture in Europe is the destruction caused by hail, and the growers are naturally interested in anything that promises to give immunity from such damage. During the past two or three years renewed interest has been taken in the matter by the vineyardists of certain parts of France and Italy. Several manufacturers have placed upon the market a special form of cannon which they claim will effectively break up hail-bearing clouds. The belief in the efficacy of this method of protection has become quite general in Europe, although scientists versed in the physics of the air have not expressed confidence in the system.

In brief the apparatus in use consists of a cannon fitted with a funnel-shaped conical extension. The difference between the various forms of cannon that are used lies mainly in the shape and size of the funnel extensions and the size of the powder charges. Usually the cannon are fired vertically upward, although in some instances the apparatus is inclined toward an advancing cloud. The effect of the funnel attachment is to cause the formation of a mass of rapidly revolving air, or vortex, which leaves the mouth of the cannon with tremendous velocity. In shape, these vortices can be likened somewhat to the rings or puffs of smoke made by a person smoking a cigar. It is claimed that these whirling masses of air, intermixed with gases from the explosives, are forced upward to a sufficient height to enter the hail cloud and destroy its hail-forming processes. If it is granted that these rings ascend to a sufficient height to enter the cloud, I am of the opinion that the force of the ring is too puny to have any appreciable effect on the cloud.

Many experiments have been made for the purpose of ascertaining the actual height to which these air rings rise before being dissipated. In a report by Profs. J. M. Pernter and W. Trabert, who, at the invitation of the Imperial Department of Agriculture of Austria and of the inventor of one of the methods, made as complete an investigation as was possible, and under various conditions, these scientists stated that they were not able to report anything positive as to the value of hail shooting. They reported that, using the largest cannon and the heaviest charges, the vortices did not ascend to a height of 1,000 feet on an average, although in some instances greater distances were obtained.

There is a marked difference of opinion as to the effectiveness of cannon firing, with the manufacturers and many grape growers on the one side and the scientists of America and Europe on the other. The former maintain that hailstorms can be prevented in the manner described, while the latter claim that the force exerted by the explosives is infinitesimal as compared to the forces of nature that are exerted in hail formation, and that experiments conducted by the adherents of the cannonading process themselves have not produced convincing results. The number of thunderstorms from which hail is precipitated is but a small percentage of the actual number. In most localities of the United States a whole season sometimes passes without a fall of hail, while in seasons of abnormal thunderstorm frequency the number of hailstorms is small. While in the grape-growing regions of France and Italy there may be greater hailstorm frequency, it is still true that the number of hailstorms are few as compared to the number of thunderstorms without hail. The experimenters score a success whenever they shoot at a thunderstorm cloud that does not produce hail, although the chances are greatly in favor of there being no hail in the cloud. Again, they excuse the occurrences of hail in

spite of a bombardment by saying that the cannon was not large enough or the powder charge sufficiently heavy, and declare that the hailstorm was far less severe than it would otherwise have been. How is one either to prove or disprove such statements?

It is true that many important discoveries have been made by experiments that were conducted contrary to scientific theories, and in the matter under discussion it is not our intention to overweight the scientist or to underestimate the practical investigator, but unquestioned facts and not explanations must be the proof of results. Scientists both in America and in Europe declare that hailstorms can not be prevented by the use of cannon and explosives of even greater power than have been used or that it is possible for man to use, and they base their belief on such knowledge of the forces of nature as science has revealed. Those opposed attempt to break down the scientists' argument by declaring that no one has yet satisfactorily explained the processes of hail formation. This is true to a certain extent, but enough is known upon which to base a logical opinion.

But there are other reasons for believing that the use of cannon and explosives in preventing hailstorms is not effective. Mr. Stiger, one of the inventors of the apparatus in use, claims that hail is formed in quiet spots in the atmosphere, where atmospheric moisture crystallizes out in large crystals in a manner analogous to the formation of large crystals of salt in liquid solution. I agree with Professor Abbe that there are no such quiet spots in the atmosphere, and hailstones are not crystals, but masses of ice with only a partial crystalline structure. Even the perfect crystals of the snowflake are formed in the midst of rapidly moving air. Hailstorms are generally local and very erratic. Some have maintained that they are controlled by the hills or the contour of the ground or by the presence of forests and lakes, and this may be true to a certain degree; but, practically, the whole question is one of ascending and descending currents that characterize whirlwinds and thunderstorms.

Several thousand shooting stations have been established in Italy and France during the past two years, but reports received from them give no definite data in support of the success of the experiments, although there is no doubt that the cannonading is believed to be effectual by the farmers who do the work. Waves of irrational enthusiasm sometimes sweep over a community, only to be regretted in subsequent years when calmer judgment has come to prevail. We have but to remember the experience of our own country only a few years ago with the rain makers, and how firm was the belief of thousands of people in the subarid and arid regions of the West that the use of powerful explosives would produce rainfall.

Thousands of dollars were expended in these experiments before the absurdity of the claim was demonstrated. It is a fact worthy of remark that the hail shooters are now using practically the same methods to dissipate the clouds that the rain makers used to produce them. Time and experiment will probably demonstrate that hail prevention by such means is as impracticable as rain production. The fact that 15,000 or 20,000 shooting stations have been established is of itself no argument as to the efficiency of the process. One might as well argue that the moon really affects the weather because a million people believe it and can prove it—to their own satisfaction.

A knowledge of the exact truth on any question of natural science

is not easily attained. The hail cannonaders base their reports of success upon such statements as "a black cloud was seen approaching, cannon were fired, and the cloud passed over without hail," or "it passed to one side and the hail did not fall on the protected vineyard, and there the hail ceased," or "the cloud broke in two, passing to the right and left, leaving the sky cloudless over the cannon." Now these are quite common cloud and storm phenomena, and they will frequently happen without cannonading. There is no way of telling by the sight of an approaching cloud whether or not it is accompanied by hail. Therefore, if the cannon be used every thunderstorm would have to be bombarded, although statistics have demonstrated that only one thunder cloud out of a great number contains hail. In other words, there would be a tremendous waste of time, money, and energy in unnecessary bombardments.

After examining all that has been published during the past two years on the subject of hail prevention, I have to repeat the opinion heretofore expressed that we have here to deal with a popular delusion, and that efforts should be made to prevent its spread in this country. The great processes going on in the atmosphere are conducted on too large a scale for any man or any nation to attempt to control them. According to Professor Abbe, the energy expended by nature in the production of a hailstorm, a tornado, or a rainstorm probably exceeds the combined energy of all the steam engines and explosives in the world. It is useless for man to attempt to combat nature on this scale.

THE MERIT SYSTEM AND THE DISCIPLINE IN THE WEATHER BUREAU.

A system of merit and discipline has been gradually developed in the Bureau, which not only conforms to the letter of the Civil-Service law, but carries its spirit to a logical conclusion. The system compels each employee or official to work out his own official salvation. It is fair to all; it enables honest and efficient persons to work themselves upward; it contributes to a high standard of manly character and to efficiency in public office, and it holds back those of mediocre attainments or of slothful habits.

The duties of the Bureau are exacting. It requires a strict discipline to administer a service with such extensive ramifications, and to have every man at his post of duty at exactly the same moment of time. To do this several times each twenty-four hours, as is necessary in the gathering and the charting of simultaneous weather observations, and in the rapid dissemination back to the country of the forecasts and warnings based upon the observations, the observers must be tractable, prompt to respond to orders, which often come by telegraph, and possessed of more than the average of education and intelligence.

The Secretary of Agriculture has given his unqualified approval to existing plans for the gradual intellectual growth and development of the clerks, observers, and other officials of the Weather Bureau.

It has been the purpose of the chief of the Bureau to recognize only the needs of the Weather Bureau and the merits of its employees in all matters of promotion, reduction, removal, or appointment, and to make only such recommendations to the Secretary as would meet his demands for an efficient service and inspire confidence among the workers of the Bureau in the fairness of the recommendations of the chief. The Secretary has been liberal in recognizing the meritorious workers of the Bureau; he expects a high standard of fitness in return.

Even before the Executive order requiring that a classified employee be given opportunity to answer charges before removal, no employee of the Weather Bureau was removed without a full investigation of his offense, and in no case was removal made of a person properly performing his duties. No person shown to be incompetent or unfit for the public service has been retained in the Bureau; and, except in one case where removal was made without the knowledge that the employee had not been given the opportunity to retrieve himself that the chief had directed, no person removed for either inefficiency or bad conduct has been reinstated.

It should not be supposed that promotion can be gained simply by passing the educational test. On the contrary, an employee must (1) make a good record for aptitude, efficiency, industry, and manly character, and (2) pass the educational test considered necessary to qualify him for the duties of the next higher grade.

Efficiency is determined from the observation of the work of the employee by his immediate official superiors and by the general appearance and the accuracy of such of the employee's work as may come under review at the central office in Washington.

Character is determined by the personal opinion of the employee's official superiors with regard to his general behavior as an officer, his social affiliations, his neatness of dress, his integrity of character, and his observances of the courtesies of business life.

Educational qualifications are determined by examination in the following subjects: English grammar, practical arithmetic, algebra (through quadratics or equations of the second degree), plane elementary trigonometry, elementary physics, popular astronomy, elementary plant physiology, and meteorology.

The educational qualifications for promotion are apportioned as follows:

For promotion to grade of \$1,000 or more per annum—English grammar, practical arithmetic, and elementary meteorology.

For promotion to grade of \$1,200 or more per annum—Elements of algebra through quadratics, elements of plane trigonometry, and elementary physics.

For promotion to grade of \$1,400 or more per annum—Popular astronomy, elementary plant physiology, and meteorology.

A proficiency of 70, on a scale of 100 as perfect, is required to pass each of the subjects.

The foregoing examinations are not obligatory and failure to take them will not of itself be made the cause of reduction. Failure to take these examinations, and thereby to become qualified for promotion, will be construed simply as an evidence of satisfaction with the grade held at the time and a tacit indication of no desire for advancement.

In order that a high standard of official integrity and manly character may obtain throughout the various branches of the Weather Bureau, it is required that a firm yet kind discipline be maintained by all officials in charge of stations. For the preservation of the peace of their offices and the efficiency of the public service, they are enjoined not to permit one subordinate secretly to impeach the integrity of another, or to carry tales about his companions. Every complaint must be stated either in the presence of the one against whom it is directed, or else in writing and be referred to him for answer, so that no unjust impression may find lodgment in the mind of a supervising officer.

The new appointee is selected from a list of eligibles certified by the United States Civil Service Commission. He can not be certified until he has passed an examination by the Commission in spelling, arithmetic, penmanship, copying from rough draft, meteorology, English composition, geography, and algebra; nor if he be under 18 or over 30 years of age. The applicant is appointed for a probationary period of six months. In each case the appointee is informed in writing, and required to acknowledge the receipt of the communication, to the effect that the policy of the Bureau, under the direction of the Department, is to recommend for absolute appointment only those persons who show complete fitness for the work of the Bureau, and he is especially cautioned that no consideration except his own worth and value to the service will have any weight whatever in determining the matter of his retention.

Experience has demonstrated the wisdom of thus impressing upon a young man's mind the idea that, beginning with the very first day of his connection with the Bureau, he stands upon his own merit. It induces him to take up his work with a purpose and determination to earn, and therefore attain, permanency of position, with results generally gratifying to him and beneficial to the public service.

Once a month throughout the probationary period the official under whose immediate supervision the employee is placed renders a report on the conduct, service, and progress of the probationer, and this official is held strictly responsible that the reports be full and impartial. If after the trial period it is clearly shown that the appointee is morally, mentally, and physically qualified, permanent appointment is made. While the rules laid down for the guidance of probationers are exacting, yet it is required that they be applied with the utmost fairness, and when early reports indicate that the prescribed standard has not been maintained, admonition is sent at once to the employee when time remains for improvement; but undesirable employees are not retained after the expiration of six months, even on the ground sometimes put forth that they may qualify if given more time to develop.

The efficiency of the service can only be maintained by a rigid system of selection, and only those fully fitted to meet the exacting requirements of the Weather Bureau receive recommendation for permanent appointment.

As an illustration of the results that may be expected to follow after a just system of promotion has been inaugurated in a Government bureau, and adhered to for several years, I point to the fact that although it was known to every person in the Weather Bureau that Congress had made provision in the present appropriation bill for an additional professor, at \$3,000 per year, and for two forecast officials, at \$2,000 each, several months before the actual appointments were made, not a single employee made application for or exerted influence to secure one of these desirable places or any of the many promotions that resulted from these appointments. I am confident that the employees of this service realized that the persons best fitted for these important offices would be selected and that personal application was unnecessary.

Such a discipline has proved its beneficence during six years of practice. It has the hearty good will of the employees of the Bureau, and the Secretary of Agriculture and the appropriations committees in Congress have sustained the chief of Bureau in its enforcement.

STORM-WARNING TOWERS.

Sixty of the new storm-warning towers referred to in my last annual report were installed during the past year, and each equipped with improved lanterns. In the majority of cases electricity is used as the illuminant. As a result of these improvements the distribution of storm warnings to shipping interests along the seacoasts and on the Great Lakes has been made much more effective. The work of placing these towers and lanterns at all the storm-warning display stations of the service will be prosecuted as fast as available funds will permit, and it is expected that 60 additional stations will be equipped by January 1, 1902.

WEATHER STUDIES IN SCHOOLS.

The increasing attention given to the subject of meteorology in schools and colleges throughout the country has resulted in large demands upon the officials of the Weather Bureau for lectures and other forms of instruction on this subject. Officials of this service have cooperated with educational institutions in this work as far as their official duties would permit.

BAROMETRIC REDUCTIONS.

The revision of the barometric system for the United States, Canada, and the West Indies is practically complete, and the results will soon be published. This work was conducted by Prof. F. H. Bigelow, and included a reexamination of the various elevations, the local and instrumental errors, the reduction of the station pressures to a homogeneous system, and the preparation of normal tables and charts of pressure, temperature, and vapor pressure at sea level, and at the 3,500-foot and 10,000-foot planes.

THE GALVESTON HURRICANE.

The principal storm of the year was the West Indian hurricane which devastated Galveston, Tex., September 8, 1900. This storm has been described in detail in the Monthly Weather Review and other publications, and it is classed as one of the most destructive storms on record. Upward of 6,000 human lives were lost and property to the estimated value of \$30,000,000 was destroyed. The following is an extract from the report of Dr. Isaac M. Cline, who was in charge of the Weather Bureau office at Galveston at that time:

The hurricane which visited Galveston Island on Saturday, September 8, 1900, was no doubt one of the most important meteorological events in the world's history. The ruin which it wrought beggars description. Conservative estimates place the loss of life at the appalling figure of 6,000.

The barometer commenced falling during the afternoon of the 6th and continued falling steadily but slowly up to noon of the 8th, when it read 29.42 inches. From noon of the 8th it fell rapidly until 8.30 p. m., when it registered 28.48 inches, a fall of pressure of about 1 inch in eight and one-half hours. At about 8.30 p. m. the barometer rose at the same rapid rate that had characterized its fall.

Storm warnings were timely, and they received a wide distribution not only in Galveston but throughout the coast region. Warning messages were received from the central office at Washington on September 4, 5, 6, 7, and 8. The high tide on the morning of the 8th, with storm signals flying, made it necessary to keep one man constantly at the telephone giving out information. Hundreds of people who could not reach us by telephone came to the Weather Bureau office seeking advice. I went down on Strand street, and advised some wholesale commission merchants who had perishable goods on their floors to place them 3 feet above the floor. One gentleman has informed me that he carried out my instructions, but that the wind blew his goods down. The public was warned over the telephone and verbally that the wind would go by the east to the south, and that the worst was yet to come. People were advised to seek secure places for the

night. As a result thousands of people who lived near the beach or in small houses moved their families into the center of the city and were thus saved. Those who lived in large strong buildings a few blocks from the beach thought that they could weather the wind and tide, one of whom is the writer of this report. Soon after 3 p. m. of the 8th conditions became so threatening that it was deemed essential that a special report should be sent at once to Washington. Mr. J. L. Cline, of this office, took the instrumental readings while I drove first to the bay and then to the Gulf, and finding that half the streets of the city were under water, I added the following to the special observation at 3.30 p. m.: "Gulf rising; water covers streets of about half of city."

The water rose at a steady rate from 3 p. m. until about 7.30 p. m., when there was a sudden rise of about 4 feet in as many seconds. At this time I was standing in the door of my residence, Rosenberg avenue and Q street. The water was about 8 inches deep in the building, and the sudden rise of 4 feet brought it above my waist before I could change my position. The ground at this point has an elevation of 5.2 feet, which made the tide 15.2 feet. The tide rose during the next hour nearly 5 feet additional, making a total tide in that locality of about 20 feet. The tide on the bay or north side of the city did not attain a height of more than 15 feet.

The prevailing wind was from the northeast until 8 p. m., when it shifted to the east and continued from this direction until 10 p. m. After 10 p. m. the wind was from the southeast and after 11 p. m. the prevailing direction was from the south or southwest. A storm velocity was not attained until about 1 p. m., after which the wind increased steadily and reached a hurricane velocity about 5 p. m. The greatest velocity for five minutes was 84 miles per hour at 6.15 p. m., with 2 miles at the rate of 100 miles per hour. The anemometer blew away at this time, and it is estimated that prior to 8 p. m. the wind attained a velocity of at least 120 miles per hour.

In commenting on the work of the Weather Bureau in issuing warning of the hurricane, the Boston Herald, of September 17, 1900, said:

The excellent service rendered by the Weather Bureau during the recent storms, which carried havoc in their path, is deserving of recognition. It was not through any lack of attention on the part of the forecasters that the victims of the hurricane on the Texas coast were overtaken by such a terrible disaster. The weather office sent out its hurricane warnings both for the Atlantic and Gulf coasts, and when the storm turned from the north of Cuba westward the Bureau turned its attention to Texas, and on the morning of the 7th, nearly thirty-six hours before the disaster, warned the people of Galveston of its coming, and during that day extended its warning all along the Texas coast, thus preventing vessels from leaving. Furthermore, the weather officials were remarkably successful in anticipating the coming of the hurricane, with less force, up toward the lakes, and thence in this direction. That such horrible disasters followed in the storm's path must be taken as showing either that the warnings were unheeded or that the havoc wrought was something inevitable.

The Chicago Inter-Ocean of September 14, 1900, said:

Simple justice demands public recognition of the efficiency of the chief of the Meteorological Bureau and his staff. They have demonstrated the usefulness in such manner as to set at rest all doubt with regard to the wisdom the Government has displayed in maintaining the weather service against all opposition and all ignorant prejudices.

After the vortex of the storm had passed Galveston it moved northward with a rapid loss of energy to Iowa, where it recurved eastward over the Great Lakes, attended by gales of unusual violence. Along this part of the storm's track ample warnings had also been sent, and a general observance of the warnings by the shipping interests reduced to a minimum the damage it caused in the lake region. On the morning of the 12th, when the storm was central in the St. Lawrence Valley, the following special bulletin was issued:

There is little doubt that severe and dangerous gales will be encountered to-night and to-morrow over the banks of Newfoundland and along the west part of the trans-Atlantic steamship routes.

Reports of incoming vessels showed that unusually severe and especially destructive gales prevailed over and near the Grand Banks during the period specified.

The following editorial from the *Marine Record*, Cleveland, Ohio, of September 13, 1900, indicates the value of the warnings to the shipping interests on the Great Lakes:

The Weather Bureau, also the officers in charge of lake stations, gave full and ample warnings of Tuesday night's gale, which swept over the lakes with such sad results to life and property. There can be no doubt but that this one warning alone has repaid the country for the outlay of the entire annual appropriation granted by Congress for the maintenance of the service. Too much credit can not be given to the chief of the Weather Bureau and the officers in charge of lake stations for the energetic and well-advised measures taken to warn vessels of the approach of the late gale and its probable severity.

FROST WARNINGS.

From September 15 to 18, 1900, a cool wave, which produced the first frost of the season, extended from the Northwestern States over the lake region, and frost occurred in the Northeastern States from September 25 to 27. Warnings of these frosts were distributed over the districts visited. The first general frost of the season in central and northern districts east of the Mississippi occurred the night of October 17-18. The occurrence of this frost was covered by the regular forecasts and by special warnings, which were issued on the morning of the 17th and telegraphed throughout the districts referred to.

In the latter part of December, 1900, and during January, 1901, severe frosts occurred in central and southern California and in Arizona, of which special warnings were issued in advance. Commenting upon these forecasts, the *Riverside (Cal.) Independent* remarked editorially as follows:

The Weather Bureau reports and predictions this season so far have been remarkably accurate, and their value can hardly be overestimated.

On the morning of February 23, 1901, the following special warning was telegraphed from Washington to Jacksonville, Fla., with instructions to give it the widest possible distribution throughout the State:

Temperature will fall to-night to a minimum of between 20 and 25 at Jacksonville and to freezing as far south as Tampa, with frost extending somewhat south of the latitude of Jupiter.

Frost occurred as predicted, and the minimum at Tampa, Fla., the night of the 23d was 32°.

Over 500 telegrams were sent from the Weather Bureau office at Jacksonville, and the railroads of the State energetically cooperated in disseminating the warnings. Fruit and vegetable growers estimated the value of orange bloom, vegetables, and strawberries known to have been saved as a result of the warnings at over \$100,000.

FLOOD WARNINGS.

The most important floods of the year occurred in the Ohio Valley in April, 1901, a detailed description of which was published in the *Monthly Weather Review* for April, 1901. The character and value of the warnings which were issued by the Weather Bureau in connection with the floods is indicated by the following editorial in the *St. Louis (Mo.) Republic* of May 7, 1901:

Hereafter it may be assumed that the Weather Bureau man will be held in high esteem throughout the Ohio Valley. During the flood period now gradually closing millions of dollars have been saved through the warnings that have been given by this branch of the Government service.

It is so seldom that the Weather Bureau receives credit for correct forecasts that the widespread commendation for the timely warnings that have been given the people of the inundated section is notable.

REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 7, 1901.

SIR: I have the honor to submit herewith a report of the operations of this Bureau for the fiscal year ended June 30, 1901.

Respectfully,

D. E. SALMON, *Chief.*

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

The past year has been one of great prosperity in all branches of the animal industry. Prices have been good, markets have been active, and there has been an outlet in foreign countries for most of our surplus.

GROWTH OF THE BUREAU'S WORK.

The work of the Bureau has been greater than ever before, and yet the facilities at its command have not been sufficient to meet the demands that have been made upon it. The magnitude of the interstate and foreign traffic in animals and their products and the amount of work required to inspect and certify to these subjects of commerce are enormous. The diseases which appear in various parts of our extensive territory each year are numerous, and there is urgent need for assistance to protect the affected communities from disastrous losses. Of scarcely less importance is it to investigate the incorrect reports of Old World plagues which are from time to time alleged to exist among our animals. These mistaken reports alarm our stock raisers, injuriously affect our markets, and lead to prohibitions by foreign countries.

OUTBREAKS OF ANTHRAX.

The past year has been remarkable for the number and wide distribution of the outbreaks of anthrax. There are certain regions where this disease appears to be indigenous, as on the alluvial soils of portions of the southern part of the Mississippi Valley, and where it apparently develops when the conditions of the soil and climate are favorable. There are, however, other outbreaks which occur as the result of importing the contagion with hides, hair, wool, etc. In either case the stock owners should be promptly informed of the nature of the disease, of its communicability to man, of its deadly nature, and of the measures required to arrest its spread.

One of the greatest resources in the fight against anthrax is the use

of a properly prepared vaccine. That supplied commercially is often unreliable. Sometimes it is so virulent that it is more dangerous than the disease it is designed to prevent; in other cases it is so lacking in activity as to be worthless. There is, however, no good reason why anthrax vaccine of proper strength should not be supplied, as blackleg vaccine has long been supplied, by this Bureau. It is only a question of having the laboratory facilities and the money for properly conducting the work.

Arkansas, Louisiana, Mississippi, and Texas have lost millions of dollars' worth of horses, mules, cattle, and other animals, and an undetermined number of human beings from this disease. Other States, among them Pennsylvania, New York, Illinois, Wisconsin, and the Dakotas, have suffered to a greater or less extent. Numerous requests for vaccine have come from the people of these sections, but it could not be supplied in any instance. More laboratory facilities and more men of thorough training must be had before this line of work can be attempted.

BLACKLEG VACCINE.

Blackleg vaccine has been supplied in greater quantities than ever before, but the facilities which the Bureau now has are not sufficient to keep pace with the demands. More than 1,500,000 doses were distributed to cattle raisers last year, and this gave the most favorable results, the losses in the vaccinated herds being less than 1 per cent of the total number.

TUBERCULOSIS.

The tuberculosis question is one which demands immediate and thorough investigation. This disease is increasing among our cattle and swine, probably also among our sheep. The value of the meat which must be destroyed each year on account of it is becoming considerable. Questions have recently been raised as to the communicability of animal tuberculosis to mankind which are of the highest importance, and should be settled at an early day. The disease is one which not only threatens the prosperity of the farmers who own the stock, but according to the weight of medical opinion at this time it is also a menace to the consumers of their products. Fortunately, the cattle of the United States are affected in less proportion than are those of any other large cattle-producing country, and it is the part of wisdom to arrest the plague now rather than to wait until the losses become greater, and the task of eradication still more difficult to accomplish.

PRESENT SALARIES FOR SCIENTISTS INSUFFICIENT.

The scientific work which is required in connection with the manufacture of anthrax vaccine, blackleg vaccine, tuberculin, mallein, and the study of diseases is of the most difficult character, and is always attended by the danger of infection with the contagion of such fatal diseases as anthrax, tuberculosis, glanders, or rabies, or with blood poisoning from handling the septic products developed in such diseases. There are few men who are qualified to do such work, and their salaries should be proportional to the difficulties and dangers which they necessarily encounter. The pay of the scientific men connected with this Bureau has been so inadequate that it is difficult to induce

competent men to remain after they have learned our methods and had the advantage of a brief period of experience in the laboratory.

The result is that much of our time is spent in training young men who, as soon as they become competent, are called away to other positions where the salaries are higher. It has been said that these men remain in the country, and the country has the benefit of the training which they have received here; and while this is true, to a certain extent, it does not improve the situation from the farmer's point of view. These men do not necessarily continue in the same line of work; some of them go as teachers where they are no longer engaged in original research; some of them go into commercial houses, and others may go into medical or veterinary practice. In all of these cases their services are absolutely lost to the field of agricultural investigation. It will probably be generally admitted that the Department of Agriculture exists for the benefit of the agricultural industry, not to educate men for professors in universities, for experts in commercial houses, or for practitioners of medicine. And, while it is desirable that men should be educated somewhere for such lines of work, their training is not a fair compensation to our stock raisers for delay in the solution of urgent and important problems or for failures to bring relief from constant and distressing losses.

While we stop to train men to fill the places vacated, the expense of maintaining the laboratory goes on, the salaries now established go on, the experiment station must be kept in operation, but the work does not progress as it should. During the past six years the position of chief of the pathological division has three times become vacant, and most of our investigators have been tendered positions with higher salaries than they are receiving here. As it requires at least two years for a new man, however competent he may be by education and preliminary training elsewhere, to become familiar with our methods, to understand our problems, and to get any reliable results from his experiments, it is readily seen that such frequent changes almost prevent the solution of the more serious and complicated questions with which we are confronted. To elucidate the practical questions connected with the control of hog cholera, for instance, requires a long series of experiments without interruption, and conducted by the same person.

It should be clear, however, that these remarks relative to educational work are not antagonistic to the policy of taking young men from colleges and technical schools into the laboratories and training them for the higher and more responsible positions. This is undoubtedly the best plan for securing competent and experienced investigators, who upon promotion are able to take up the most advanced work with the least loss of time. It is not the educational process that the writer deplures, but the loss of men from this service almost as soon as they have been fitted for it at such an expense of time and money.

It is therefore very desirable and, indeed, essential to the successful prosecution of the scientific work which the Bureau should do that the salaries be made equal to those paid in educational institutions and in other branches of scientific work conducted by the Government. There is no apparent reason why a scientific man should work for less compensation in the Department of Agriculture than in other departments of Government service requiring no more training and no greater competency. As a matter of fact, they will not do so, and the work of agricultural investigation suffers accordingly. I would

therefore most urgently recommend that the compensation of the chiefs of the scientific divisions of this Bureau and their more important assistants be made commensurate with the high class of work required of them.

MEASURES TO EXCLUDE CONTAGION.

The maintenance of properly equipped and efficient quarantine stations is essential to the protection of our live stock from imported contagion. The increased value of animals of all kinds in the United States has led to larger importations and to correspondingly greater danger of bringing disease into the country. There may be a reasonable doubt as to whether it is necessary or even advantageous to bring any new breeds of animals or any fresh blood of old breeds into this country, but there can be no question that it would be far better to have no more breeding stock imported than to allow the entrance of diseased animals, which are capable of spreading contagion among our domestic stock and causing heavy loss to our farmers for years to come. Foreign countries in which we desire to market live animals are from time to time making inquiries as to the value of our quarantine stations and the protection which we give to our live-stock industry. It may be, therefore, that the continuance of our exports in the countries to which we now ship, as well as the extension of our trade to countries where it is desired to establish a trade, is dependent upon our exclusion of diseased animals.

The quarantine stations now in use have been sufficient in the past, but with the growth of the import trade more facilities are required. Ground for a station for the quarantine of animals entered at the port of New York has recently been purchased at Athenia, N. J., and buildings are now in course of erection. The increased cost of building material and the greater number of buildings required make it impossible to equip properly this station for the money which has been appropriated. The work should therefore be continued another year. There is also great need for a quarantine station on the water front, to which animals can be taken by boat in all cases where there is any suspicion that they may have been exposed to disease. This would be far safer than transportation by rail, as at present. There is no place so situated available near New York, and it would therefore be advisable to purchase land for such a station somewhere on the extensive shore line in the vicinity of Baltimore. The quarantine station for the port of Baltimore, now located at St. Denis, Md., needs extensive repairs or entirely new buildings, and consequently this would be a favorable time to make a change.

With a station such as is contemplated, animals might be admitted which we are now obliged to exclude. All cattle, sheep, and swine from the Continent of Europe, for example, are now forced to enter through the Canadian quarantines, because of the prevalence of foot-and-mouth disease in Europe and the danger that would be connected with the transportation of such animals by rail immediately after landing, even if they were apparently sound on inspection. In the history of the quarantine stations, before they were administered by the Bureau of Animal Industry, there are several instances in which foot-and-mouth disease was not detected by the inspection on shipboard, although the animals were actually affected. Such instances are liable to occur again, and emphasize the importance of adopting every possible precaution. An outbreak of foot-and-mouth disease would cause

not only great loss to our stockmen whose animals were affected, but it would probably lead to the prohibition of our cattle and sheep by other countries. The recent destruction of the magnificent livestock trade of Argentina by an outbreak of this disease should be a warning as to what may at any time happen to the United States if our vigilance is relaxed or if we fail to adopt every precaution that may be reasonably suggested from an intimate knowledge of this elusive contagion.

A disease which can not be excluded even by quarantine is tuberculosis. The slow and insidious nature of this disease, the difficulty of detecting it, the fact that it may be communicated to all species of animals, and its generally fatal character, make it by far the most dangerous and injurious of the plagues which threaten our live stock. Unfortunately, it has already become so well known that familiarity has bred contempt, and its powers for evil are not fully appreciated. Notwithstanding the tuberculin test, it is to be feared that tuberculous cattle sometimes gain entrance to this country by the fraudulent practice of treating them with this agent before the regular test is made, and thus putting them into a condition which prevents them from showing its effects. As animals imported for breeding purposes are generally sold either to some breeder of high-class stock or to some farmer or dairyman who is grading up his cattle, every tuberculous animal imported is liable to start a new center of disease, and every center of disease so established becomes a distributing point for the contagion and causes an amount of damage which can not be fully appreciated until years afterwards. As has been officially determined of a celebrated herd in Canada, wherever cattle from that herd were found there also was found tuberculosis, "and the Bow Park herd, which was looked upon as one of the greatest benefits to the farming community in western Canada, was really a danger, because it disseminated tuberculosis among the ordinary farmers' herds."

In the same way our owners of pure-bred herds are not only courting danger to their own herds when they admit doubtful cattle from abroad, but they are liable to disseminate the disease through the herds of many innocent purchasers of their stock. Notwithstanding this fact, there is an unreasonable and insistent demand by the speculators and others interested in the handling of such stock that the regulations be relaxed to such an extent that the detection of diseased cattle would be impossible. The very fact of this insistence indicates that the present regulations are found inconvenient, and that a profitable though dangerous traffic has been checked. It is needless to add that these regulations should be enforced in the interest of our farmers, in the interest of the public health, and in the interest of our export trade, and if the present restrictions are not sufficient to exclude disease they should be added to and made more rigid until the object is accomplished.

FOREIGN MARKETS FOR LIVE STOCK.

The number of cattle and sheep exported during the past year shows a gratifying increase of this branch of our trade. Most of these animals have gone to Great Britain for immediate slaughter. It is believed that the time has come when an effort should be made to introduce our fine breeding animals to the stockmen of other countries. Our herds are now as good as any in the world. The importation of breeding stock from Europe is, except in very rare cases, for speculation

only, not because the blood is needed to improve our animals; and during recent years the tendency of such importations has often been detrimental rather than beneficial. This tendency is fully appreciated by the breeders, as is shown by the almost prohibitive registration fee which has been imposed by the Shorthorn Association.

The Argentine Republic has long been importing high-priced breeding stock from Europe, but recently has prohibited the trade on account of the danger of admitting disease from that section of the world. The stockmen of Mexico begin to realize the benefits which would accrue to them by producing animals which would conform more nearly to modern requirements. South Africa, stripped of its live stock by the exigencies of a long and stubbornly contested conflict, must in the near future be rehabilitated and begin anew the development of an extensive pastoral industry. What is more natural than that the finely bred and healthy herds of the United States should be drawn upon to supply the wants of these countries?

Just at present the demand for such stock at home is almost too great to favor very active efforts to build up an export trade. But this condition will not long continue because the stimulus of good prices will lead to much greater production and then a foreign outlet will be very desirable. An export trade can only be built up, however, by supplying the highest quality of stock and that which is free from disease. Of foot-and-mouth disease and pleuropneumonia we are free, and probably shall remain free, but the attention of the world is now turned to tuberculosis, and we should put our herds in condition to also guarantee freedom from that plague. Argentina, Australia, and New Zealand have felt the disastrous effects of tuberculous breeding stock, and it is not likely that any country hereafter will admit such animals without the most rigid tests. Neither should animals be admitted into the United States without these tests, if the reputation of our herds is to be maintained.

IMPROVEMENT IN CATTLE SHIPS.

There has been great improvement recently in the vessels carrying live stock to Great Britain, as a consequence of the Department regulations requiring wider alleyways and better ventilation. In some of the older ships it was impossible to widen the alleys to the extent demanded without too great interference with the carrying capacity, and in these the object sought was attained by running alleys athwartship and increasing the ventilation. It is believed that now, after a continuous struggle for ten years, these vessels are at last in condition to carry animals humanely and without unnecessary loss. During this long period one concession after another has been obtained from the transportation companies, some willingly and some unwillingly, with the result that a gradual improvement has followed.

There remains still in an unsatisfactory condition the method of securing attendants to take care of the cattle during the ocean voyage. At present, many of these men are ignorant foreigners, unable to speak our language, who are engaged under misrepresentation as to the character of the work and with promises of compensation and of a return passage which are never made good. The result is great hardship and cruelty to the men and lack of attention to the cattle, because the men are not familiar with the work and only perform it under compulsion. No efficacious method of correcting this evil has yet been devised, but it is now receiving the attention of the several

Departments of the Government which are interested, and it is hoped that some practical measure will be evolved.

INCREASE IN MEAT INSPECTION.

The number of cities where meat inspection is conducted has been increased by 13 per cent during the year; the number of carcasses inspected at the time of slaughter increased by 2,300,000. This, of course, means that the expense of the inspection is also increasing. However, meat inspection is a service of great value to the country, protecting consumers from diseased meats and maintaining the reputation of our animal products in both home and foreign markets. At present the field is not covered. There are many abattoirs asking for inspection to which the service can not be extended. The work must therefore continue to grow for some years, but arrangements should soon be made to inspect all meat shipped from one State to another. Until this is done the objects in view when the service was established have not been entirely accomplished.

INSPECTION OF DAIRY PRODUCTS FOR EXPORT.

At the last session of Congress provision was made for the inspection and certification of dairy products intended for exportation. The regulations for carrying this measure into effect have been made and the inspection will soon be commenced. The cost of this inspection can not be estimated in advance, but it will necessarily increase the Bureau expenditures, though not largely, considering the benefit that should accrue. At a time when butter substitutes, renovated butter, and all grades of dairy and creamery butter are exported from this country, it is necessary for the protection of our pure butter in the markets of the world that there should be a proper official inspection and certification before the goods leave this country. Practically the same may be said in regard to cheese. The trade is large and increasing, and is entirely worthy of this degree of Government supervision. Whatever the cost may be, therefore, it is an expenditure wisely made, and one which will be of assistance to the dairy industry. It is the intention to extend this inspection gradually, first certifying to the better grades of pure butter and allowing other grades to go upon their merits, but later perhaps marking all grades.

STATE RESTRICTIONS ON INTERSTATE CATTLE TRAFFIC.

Inspection laws and regulations are enforced in a few States, which duplicate the inspection made by this Bureau, of animals that are shipped from one State to another, and for such State inspection fees are demanded which constitute a serious burden on this branch of interstate commerce. The State inspection and tax is applied to live stock which is simply in transit across the territory of the State as well as to that which is destined to remain within its borders. It is plain that the imposition of such taxes on the live-stock traffic by a few States may be followed by the general adoption of this method of raising revenue, and that this would work to the great disadvantage or possibly to the ruin of the stock industry in sections of the country which are remote from market. It would be next to impossible, for instance, to ship cattle from Massachusetts to California, if every intermediate State whose territory was crossed en route should

require inspection and exact a fee for the same. So menacing is this situation to the great cattle industry of the Southwest and West that efforts are being made by the National Live Stock Association to bring the matter before the Supreme Court of the United States, in order that a decision may be rendered as to the constitutionality of these State restrictions upon interstate commerce when Congress has already legislated upon the subject and provided an adequate inspection service. I would recommend that the Department of Agriculture take such action as it properly may to interest the Department of Justice and to secure its assistance in presenting the case.

INSPECTION DIVISION.

MEAT INSPECTION.

The number of abattoirs and packing houses where cattle, sheep, calves, and hogs and their products were inspected during the year was 156. The number noted in the preceding report was 148. The number of localities where the work was conducted increased from 45 to 51. Horses were inspected at one other abattoir.

The following table shows the increase year after year in the number of abattoirs where inspection has been maintained and the number of cities where the work is done:

Number of abattoirs and cities where inspection was maintained, 1892 to 1901.

Fiscal year.	Number of abattoirs.	Number of cities.	Fiscal year.	Number of abattoirs.	Number of cities.
1892.....	28	12	1897.....	128	33
1893.....	37	16	1898.....	135	35
1894.....	46	17	1899.....	138	41
1895.....	55	19	1900.....	148	45
1896.....	102	26	1901.....	156	51

The following table shows the numbers and kinds of animals inspected before slaughter, and the number of these that were rejected for some cause apparently unfitting them for food purposes, the final condemnation or passing of the carcass depending upon the result of the post-mortem inspection:

Ante-mortem inspections for the fiscal year 1901.

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities and miscellaneous buyers.	Total inspections.	Rejected (subject to result of post-mortem inspection).	
				At abattoirs.	In stock yards.
Cattle.....	5,375,315	4,904,883	10,280,198	318	14,727
Sheep.....	6,662,632	4,571,827	11,233,859	890	7,682
Calves.....	400,241	266,235	666,476	1,635	2,173
Hogs.....	24,486,130	9,700,656	34,186,786	5,812	71,286
Horses.....	1,991		1,991	3	
Total.....	36,925,709	19,443,601	56,369,310	8,658	95,868

There was an increase over last year in the number of all classes of animals inspected, with the exception of a decided decrease in the number of horses, there being but a third as many of these as

during the previous year. The total number of ante-mortem inspections this year exceeds the total number of last year by 3,281,316. There was an increase of 2,700 rejections at abattoirs and a decrease of 57,693 rejections at stock yards.

The following table, showing the total number of animals inspected at time of slaughter for abattoirs having inspection, for the fiscal years 1891 to 1901, is given for the purpose of comparison:

Number of animals inspected at slaughter for abattoirs having inspection, fiscal years 1891 to 1901.

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889					83,889
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,079	92,947	870,512			4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146		12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539		18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191		23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771		26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199		31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936

The inspection of animals at time of slaughter, with the number of carcasses and parts of carcasses condemned and tanked, is shown in the next table. The number of condemnations for trichinosis is given under the head of "Microscopic inspection of pork."

Post-mortem inspections for the fiscal year 1901.

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned at abattoirs.
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards.	Total.	
Cattle	5,219,149	25,005	5,244,154	8,505	3,777	12,282	8,701
Sheep	6,639,212	7,349	6,646,561	2,936	1,513	4,449	91
Calves	413,830	750	414,580	385	150	535	24
Hogs	24,642,753	77,729	24,720,482	47,240	7,394	54,634	10,973
Horses	1,992		1,992	103		103	
Total	36,916,936	110,833	37,027,769	59,169	12,834	72,003	19,789

In addition to the carcasses condemned as above and to those condemned for trichinosis, the table below shows the number tanked for other reasons—bodies of dead animals taken from cars or pens at abattoirs, or animals that, after inspection in the stock yards, had died from disease or injury or were killed by municipal inspectors:

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Died in stock yards	316	1,147	118	2,215		3,796
Killed in stock yards	497	600	158	9,203		10,458
Died at abattoirs	239	1,061	257	15,388	27	16,972
Total	1,052	2,808	533	26,806	27	31,226

Below is a statement of the total number of carcasses and parts condemned and tanked, with the causes of condemnation, at the time of

slaughter, and including the carcasses of animals found dead and those killed by city inspectors:

Causes of condemnation of carcasses and parts of carcasses for fiscal year 1901.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.
Actinomycosis	1,355	629	2	-----	5	-----	26	3	-----
Tuberculosis	6,454	256	134	-----	8	-----	8,650	44	-----
Cholera and swine plague ..	-----	-----	-----	-----	-----	-----	37,862	-----	-----
Texas fever	17	-----	-----	-----	12	-----	-----	-----	-----
Echinococcus	1	1	1	-----	-----	-----	-----	620	-----
Measles	-----	-----	-----	-----	-----	-----	24	-----	-----
Scabies	-----	-----	26	-----	-----	-----	87	-----	-----
Eczema	-----	-----	-----	-----	-----	-----	6	-----	-----
Erysipelas	-----	-----	-----	-----	-----	-----	23	-----	-----
Cancer	63	-----	2	-----	-----	-----	18	-----	-----
Tumor	21	8	5	-----	1	-----	480	668	-----
Abscess	98	6,485	110	11	6	4	597	1,570	6
Pneumonia	213	-----	177	-----	15	-----	978	-----	3
Pleurisy	13	-----	23	8	1	-----	88	13	1
Bronchitis	-----	-----	-----	-----	-----	-----	-----	-----	-----
Carditis	-----	-----	-----	-----	-----	-----	2	-----	-----
Enteritis	36	-----	62	-----	14	-----	286	-----	3
Peritonitis	177	-----	52	-----	16	-----	373	-----	1
Metritis	9	-----	6	-----	-----	-----	117	-----	3
Nephritis	7	-----	63	-----	2	-----	44	-----	-----
Uræmia	1	-----	27	-----	-----	-----	30	-----	-----
Mammitis	1	-----	4	-----	-----	-----	15	400	-----
Septicæmia	268	-----	212	-----	6	-----	684	-----	17
Pyæmia	200	-----	183	-----	12	-----	1,899	-----	4
Gangrene	12	-----	6	-----	-----	-----	33	-----	1
Anæmia, emaciation, marasmus ..	2,173	-----	1,835	-----	47	-----	299	-----	11
Ascites	19	-----	51	-----	1	-----	27	-----	-----
Jaundice	26	-----	258	-----	4	-----	774	-----	-----
Extreme temperature, various causes ..	2	-----	41	-----	4	-----	595	-----	-----
Pregnancy	76	-----	25	-----	-----	-----	269	-----	40
Recent parturition	15	-----	15	-----	-----	-----	63	-----	-----
Hernia	2	-----	4	-----	-----	-----	31	-----	-----
Downers, bruised, injured, etc ..	1,020	1,322	759	62	52	20	254	7,655	4
Asphyxiation	3	-----	-----	-----	-----	-----	-----	-----	-----
Sick	-----	-----	31	-----	-----	-----	-----	-----	-----
Caseous lymphadenitis	-----	-----	333	-----	-----	-----	-----	-----	-----
Impaction of rumen	-----	-----	1	-----	-----	-----	-----	-----	-----
Distoma	-----	-----	1	-----	-----	-----	-----	-----	-----
Melanosis	-----	-----	-----	-----	1	-----	-----	-----	2
Polyarthrititis	-----	-----	-----	-----	1	-----	-----	-----	-----
Too young	-----	-----	-----	-----	327	-----	-----	-----	-----
Lymphangitis	-----	-----	-----	-----	-----	-----	-----	-----	1
Pharyngitis	-----	-----	-----	-----	-----	-----	-----	-----	1
Nasal discharge	-----	-----	-----	-----	-----	-----	-----	-----	2
Fistula	-----	-----	-----	-----	-----	-----	-----	-----	1
Distemper	-----	-----	-----	-----	-----	-----	-----	-----	2
Dead from various causes ..	555	-----	2,208	-----	375	-----	17,603	-----	27
Killed by city inspectors ..	497	-----	600	-----	158	-----	9,203	-----	-----
Total	13,334	8,701	7,257	91	1,068	24	81,440	10,973	130

The meat inspection tag or brand was placed upon 18,977,943 quarters, 332,399 pieces, and 2,844 sacks of beef; 6,626,729 carcasses of sheep; 412,721 carcasses of calves, and 1,101,961 carcasses of hogs, and 752,805 sacks of pork.

The stamp signifying that the contents had received the ordinary inspection was affixed to 21,496,109 packages—6,394,065 of beef, 41,993 of mutton, 112 of veal, 15,059,118 of pork, and 821 of horse-flesh.

There were sealed (with numbered seals, of which a record is kept) 68,495 cars containing inspected meat products for shipment to official abattoirs and other places.

The number of certificates of ordinary inspection issued for meat

products for export, exclusive of horseflesh, was 36,998. Of beef, there were 1,749,817 quarters, 330 bags, 36,554 pieces, and 1,437,553 packages, with a weight of 452,830,373 pounds; of mutton there were 452 carcasses and 18,990 packages, weighing 894,648 pounds; of pork there were 53,203 carcasses and 717,749 packages, the weight being 231,144,938 pounds. These figures show an increase in the exports of beef and mutton, but a falling off in pork, the total difference being (in round numbers) 26,000,000 pounds less than in 1900—the gain of 15,000,000 in beef being offset by a loss of 40,000,000 in pork. In 1900 there was an increase over 1899 of 77,000,000 pounds in beef, and a decrease of 6,000,000 pounds in pork.

There were 9 certificates given for horseflesh, covering 880 packages, having a weight of 249,900 pounds.

The following table shows the quantities of beef, mutton, and pork for export which received the certificates of inspection:

Quantities of beef, mutton, and pork for export upon which certificates of inspection were issued 1898 to 1901.

Fiscal year.	Beef.	Mutton.	Pork.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1898.....	339,650,091	324,996	244,956,482
1899.....	360,843,856	525,705	278,696,435
1900.....	438,138,233	680,897	272,050,663
1901.....	452,830,373	894,648	231,144,938

The expense incurred on account of the work outlined above was \$566,809, an increase over last year of \$61,528.48. The cost of each of the 56,369,310 ante-mortem inspections averaged 1.01 cent.

The following statement shows the cost of each ante-mortem inspection from 1893 to 1900, inclusive:

	Cents.		Cents.
1893.....	4.75	1898.....	0.80
1894.....	1.75	1899.....	.83
1895.....	1.10	1900.....	.95
1896.....	.95	1901.....	1.01
1897.....	.91		

MICROSCOPIC INSPECTION OF PORK.

The number of carcasses of pork examined was 733,196, classified as follows: Class A (free of all appearance of trichinæ), 715,529, or 97.59 per cent; Class B (containing trichina-like bodies or disintegrating trichinæ), 8,668, or 1.18 per cent; Class C (containing living trichinæ), 8,999, or 1.23 per cent. There is little change in the percentages; Class A slightly increased, with a corresponding diminution in Class C.

There were 9,001 trichinous carcasses disposed of during the year; the weight of these was 2,003,858 pounds. Over half of this quantity was made into cooked meat; the remainder was tanked.

The decrease in the exports of microscopically examined pork continued, so that the quantity inspected for export amounted to less than two-thirds of that of the year before. The number of certificates issued was 6,188; the number of packages was 127,017, with a weight of 35,942,404 pounds. For comparison the quantities inspected for

export to countries requiring microscopic certificates for 1892 to 1901 are given:

	Pounds.		Pounds.
1892.....	22,025,698	1897.....	42,570,572
1893.....	8,059,758	1898.....	120,110,356
1894.....	18,845,119	1899.....	108,858,149
1895.....	39,355,230	1900.....	55,809,626
1896.....	21,497,321	1901.....	35,942,404

The expenditures on account of this work amounted to \$114,102.76. This gives an average for each examination of 14 cents; for each pound exported, of 0.317 cent.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

The number of certificates of inspection issued for American cattle exported to Europe was 1,563; the number of clearances of vessels carrying inspected live stock was 988. There was a notable increase in the number of cattle and sheep exported, the former being greater than in any year since 1898 and the latter the largest since 1896. There was a decline in the exportation of horses. All of the animals in the following table were exported to Great Britain, with the exception of 80 cattle, 590 sheep, and 858 horses to Belgium, and 914 horses to Germany:

Number of inspections, etc., of American and Canadian animals, fiscal year 1901.

Kind of animal.	American.				Canadian.		
	Number of inspections.	Number rejected.	Number tagged.	Number exported.	Number inspected.	Number rejected.	Number exported.
Cattle.....	804,578	1,682	400,385	a 384,722	33,385	13	33,372
Sheep.....	398,845	606	-----	b 227,934	49,209	67	49,142
Horses.....	47,679	263	24,235	c 24,952	582	-----	582
a 9,780 via Canada.				b 13,552 via Canada.			
				c 267 via Canada.			

Besides the above-mentioned animals exported to Europe, there were also inspected 800 cattle, 514 sheep, and 1 horse for Bermuda and 82 cattle for Brazil.

The number of American and Canadian animals landed alive at the foreign animals wharves in London, Liverpool, and Glasgow and inspected by inspectors of this Department stationed at those ports, together with the number and percentage lost in transit, is shown as follows:

Number of animals inspected at time of landing in London, Liverpool, and Glasgow and loss in transit, fiscal year 1901.

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	No.	No.	Per ct.	No.	No.	Per ct.	No.	No.	Per ct.
United States	366,629	868	0.24	207,477	1,913	0.91	22,823	400	1.72
Canada	28,975	110	.38	46,850	425	.90	528	10	1.86
Total.....	395,604	978	.25	254,327	2,338	.91	23,351	410	1.73

INSPECTION OF IMPORTED ANIMALS.

The numbers and classes of animals imported from Mexico and inspected at ports of entry along the international boundary line are given in the table on the next page.

Importation of Mexican animals, fiscal year 1901.

Port of entry.	Cattle.	Sheep.	Swine.	Goats.	Horses.	Asses.
Eagle Pass, Tex.	3,640				3	6
El Paso, Tex.	49,413			2	94	
Naco, Ariz.	207					
Benson, Ariz.	29					
Nogales, Ariz.	41,682			143		2
San Diego, Cal.	1,680	1,357	37	1,272		1
Total	96,651	1,357	37	1,417	97	9

Through ports on the seacoast animals not subject to quarantine were imported as follows:

From—	New York.		Boston.		San Francisco, horses.	Total.
	Horses.	Mules.	Horses.	Shetland ponies.		
Europe	1,217		23	3		1,243
Cuba	16	700				716
Brazil		2				2
Bermuda	16					16
Porto Rico	4					4
Hawaii					5	5
Manila					7	7
Mexico	3					3
China					1	1
Canada			23	1	3	27
Total	1,256	702	46	4	16	2,024

There were also 1 deer imported from Manila through San Francisco and 6 sheep from Canada through Boston.

A report of the animals imported and quarantined at different stations will be found under the head "Miscellaneous division."

CONTROL OF CONTAGIOUS DISEASES.

Southern cattle inspection.—The supervision of the movement of cattle from the area quarantined on account of Southern, or Texas, or splenic fever of cattle, due to the presence of the tick (*Boophilus annulatus*, formerly called *Boophilus bovis*), which carries the infection, involved the proper yarding in the quarantine divisions of the different stock yards of 1,168,935 head of cattle, during the quarantine season of 1900. To transport these cattle required 43,952 cars, each of which had to be placarded, and all of the waybills, manifests, and bills of lading accompanying the shipments had to state that the cattle were Southern cattle. The number of cars cleaned and disinfected was 45,425.

In Texas, 307,658 cattle were inspected and identified by brands as originating outside of the quarantined district and were permitted to be moved north for grazing.

Scabies in sheep.—The number of sheep inspected in stock yards, at feeding stations, and at many places throughout the West, in order to prevent the shipment of sheep affected with, or that had been exposed to, scabies, amounted to 7,912,724.

The number of sheep dipped under the supervision of Bureau inspectors was 1,034,368.

For shipments of sheep that were found free of infection, certificates of inspection were given.

MISCELLANEOUS DIVISION.

The miscellaneous division has a general supervision of the accounts and other work of the Bureau of Animal Industry, as follows: Salaries; reimbursement of expenses incurred by its officers and employees in travel and at various stations; apparatus and supplies for the various divisions, their laboratories, the experiment station, and quarantine stations; all accounts of every character that are paid from the appropriation for the Bureau of Animal Industry; the preparation of an itemized report to each Congress, showing in detail the character of expenditures and the use of the appropriation; the making out of all appointments, transfers, promotions, furloughs, reinstatements, resignations, and dismissals; the making of requisitions and informal bids for all materials and supplies used throughout the work of the Bureau, and the necessary letter writing incident thereto, together with the supervision of the work of the animal quarantine stations. This latter work includes the inspection and quarantine of imported cattle, sheep, and other ruminants, and swine, and the making of permits for their importation and keeping the records pertaining to quarantines. The division also has charge of the preparation of replies to numerous letters requesting information in regard to the diseases of animals and poultry, their causes and treatment, and various other matters pertaining to breeds, breeding, and care of domesticated animals, and allied subjects. This is the character of the routine work performed each year.

QUARANTINE OF IMPORTED ANIMALS.

The variety of kinds and the number of ruminants other than cattle and sheep imported during the fiscal year has been increased somewhat through the importations made more especially for exhibit at the Pan-American Exposition. These animals have all been subjected to inspection and quarantine, the length of the quarantine period being fixed in accordance with the requirements for the subdivision of the class to which the animal belonged.

The imports of animals from Canada not subject to detention at quarantine stations comprised 39,572 cattle, 199,325 sheep, 3,227 horses, 435 hogs, 1 goat, 7 deer, and 3 elks—total, 242,570 animals.

The following table shows the number and kinds of animals detained in quarantine for the requisite time:

Number of animals imported and quarantined at different stations, fiscal year 1901.

Stations.	Cattle.	Sheep.	Hogs.
Littleton, Mass.	11	128	7
Garfield, N. J.	359	270	66
Port Huron, Mich.	11	.....	.....
Detroit, Mich.	5	.....	.....
Sault Ste Marie, Mich.	31	.....	2
Ogdensburg, N. Y.	3	.....	1
Hogansburg, N. Y.	6	.....	2
Messina, N. Y.	4	.....	.....
Buffalo, N. Y.	7	.....	.....
Niagara Falls, N. Y.	3	.....	.....
Richford, Vt.	10	.....	1
St. Albans, Vt.	2	.....	.....
Newport, Vt.	16	14	.....
Island Pond, Vt. ....	.....	3	.....
Beecher Falls, Vt.	33	10	.....
Houlton, Me.	55	73	2
Vanceboro, Me.	1	17	.....
Eastport and Calais, Me.	2	10	.....
Total.	559	525	81

There were also imported through the port of New York and quarantined, under the supervision of the superintendent of the Garfield quarantine station, the following: Antelopes, 4; buffalo, 4; giraffe, 1; guanacos, 2; aoudads, 2; nilgaus, 2; camels, 16; goats, 9; alpacas, 2; chamois, 1; deer, 37; zebu, 1; llamas, 9; gazelles, 3; trick bull, 1; other wild animals, 24—total, 118. Add to this the animals reported in the table above, we have a total of 1,283 imported animals that were quarantined.

An official veterinarian was stationed at London, England, in accordance with the requirements of Bureau of Animal Industry order No. 79, issued by this Department under date of November 10, 1900, which provides for the testing with tuberculin by an inspector of this Department of all cattle over six months old which are to be imported into the United States. This official has tested, in various parts of Great Britain, 161 cattle, for which a permit was desired for shipment to the United States. Of these, 18 were rejected and 143 passed. In Canada the veterinarians of this Department tested with tuberculin 491 cattle, of which 39 were rejected and 452 passed.

OUTBREAK OF MALADIE DU COÏT.

During the last quarter of the fiscal year the work of eradicating an imported infectious venereal disease of horses known as *maladie du coït*, or dourine, was inaugurated, but owing to the extent of area and the semiwild condition of much of the country over which the disease had spread, as comprised in the Rosebud and Pine Ridge Indian agencies, South Dakota, and parts of Nebraska and Wyoming, little was accomplished beyond the organization of the work. A large number of range horses were rounded up, corralled, and inspected previous to July 1, among which 12 were found to be affected with the disease. These, comprising 2 stallions and 10 mares, were appraised through agreement with the owners and subsequently slaughtered.

Animals found diseased with maladie du coït and killed, and amount of indemnity paid.

Animal.	Owner.	State.	Indemnity.
Stallion	C. W. Denton	Nebraska	\$25.00
Mare	S. Chamberlain	Nebraska	20.00
Mare	William Shannon	Nebraska	35.00
Mare	William Shannon	Nebraska	35.00
Stallion	A. A. Lamb	South Dakota	35.00
Mare	P. H. Beguin	Nebraska	10.00
Mare	A. Williams	Nebraska	20.00
Mare	Plenty Birds	South Dakota	20.00
Mare	C. R. Wolfenden	South Dakota	25.00
Mare	L. B. Lessert	South Dakota	30.00
Mare	J. H. Dixon	South Dakota	30.00
Mare	J. H. Dixon	South Dakota	30.00
Total .....	.....	.....	315.00

The following outline of a report received from Dr. W. S. Devoe, the inspector in charge of this work, exhibits its character:

PINE RIDGE AGENCY,
South Dakota, June 4, 1901.

There are five districts on this reservation—Wakpamini, White Clay, Porcupine, Wounded Knee, and Medicine Root. The animals are rounded up in each district and driven to the final round-up at Pass Creek district, 47 miles from the agency, and then animals which have estrayed from one district to the other during the

year are returned, and animals straying in from sections of the country covering 100 miles in area through Nebraska and South Dakota are claimed by owners and removed by them. At the round-up there were present at least 300 men from different sections—horse buyers from Iowa and Omaha, as well as breeders from Nebraska and South Dakota.

On finding a sorrel mare which was badly diseased, I asked the name of the owner, but no one would acknowledge the ownership of the animal. It was reported by men who knew the brand that she came from the sand hills southeast of Gordon, Nebr. I assumed the responsibility in case a claim was made for indemnity, killed the mare, and made a post-mortem examination to give those present an opportunity to learn more of the nature of the disease. The lesions of *maladie du coit* were very pronounced.

It was the desire of the breeders and owners of the horses present that the other diseased animals found should be killed on the spot, but not knowing who the owners were and wishing to show the people of this section the disease in its various stages, they were removed to the agency.

Several diseased animals have been slaughtered without indemnity, as they were unclaimed.

BIOCHEMIC DIVISION.

ROUTINE WORK.

The routine work of preparing and shipping branding ink, tuberculin, and mallein has been continued as heretofore. This division has shipped about 560 gallons of branding ink for use in marking inspected meats, 44,410 doses of tuberculin, and 7,188 doses of mallein. The routine work in connection with serum experiments, hog cholera, and swine plague have been continued. A large number of herds were treated in the West during the summer and fall of 1900 and the spring of 1901, and the work is being continued at the present time. In general, the results have been of an encouraging character. At the same time, in some herds other factors have arisen for consideration, which have been and are now being investigated with the hope of throwing additional light on the methods of handling these troublesome diseases.

All this work has entailed a large amount of routine work in the preparation of cultures for the inoculation of animals, in the preparation of serum, and especially in the identification of cultures obtained from herds in the West which have been under treatment. In the progress of this work a number of new varieties of bacilli belonging to the hog-cholera group have been isolated, and other important properties and variations have been carefully studied.

LABORATORY WORK IN TUBERCULOSIS.

The work in connection with tuberculosis has been continued. A number of germs from different species of animals have been secured and cultures made with the purpose in view of obtaining sufficient material for continuing the biochemical and other investigations already begun. The experiments with the serum for tuberculosis in the human being have also been continued at one of the sanatoriums in New York, and the results, as reported by the physician in charge, are of a very encouraging character. Some feeding experiments on chickens have also been conducted during the year and the results are about ready for publication. A number of routine analyses and examinations have been made as the work demanded. A large number of investigations in connection with tuberculosis, in addition to those already named, have been begun, and special attention will be given to the injury to man from bovine, or rather animal, tuberculosis.

There has been some investigation in connection with milk, and

arrangements have been made for a careful study of the bacteriologic and biochemic factors in the production of flavor in butter and cheese. This work will be continued as soon as possible.

Investigations along the lines indicated above will necessarily be continued during the coming year, and other subjects will be taken up as the facilities of the division will permit.

PATHOLOGICAL DIVISION.

The work of the pathological division has been continued along the same lines as during the previous year, with the exception that increased facilities have made it possible to devote more time to the investigation of pathological anatomy. The number of specimens received from the members of the inspection division of this Bureau, as well as from outside parties, have increased by more than 200 per cent over that of any previous year.

BLACKLEG.

The preparation and distribution of blackleg vaccine have, with the increased experience of the assistants detailed to this work, become more of a matter of routine, without sacrificing any of the care and attention which this line of the work demands.

During the fiscal year there were prepared 1,582,625 doses of blackleg vaccine, and of this amount approximately 42,000 doses were discarded as not meeting the requirements for vaccine that is both safe and effective. There were distributed 1,517,560 doses among 12,013 cattle owners. This is an increase of more than 50 per cent over the previous year, when the total number of doses sent out was 1,076,150. The work in this connection has necessitated the preparation and sending of 30,490 pieces of mail, as well as the filing and tabulation of approximately the same number of letters and reports; also the writing and filing of about 20,000 cards for the personal and geographic card catalogue.

From reports received, it is safe to conclude that the loss from blackleg in all herds where this vaccine has been used will fall below 1 per cent, although it is the general impression that the past year has been what is known as a "bad blackleg year" throughout the entire country. It is gathered from information received from all States and Territories that without vaccination the loss from blackleg would have been greatly in excess of that which is generally experienced. The expenses in connection with the preparation and distribution of this vaccine have not exceeded those of the previous year, when only 1,076,150 doses were distributed.

RABIES.

From numerous reports received from various parts of this country it appears that rabies is greatly on the increase among dogs and other domesticated animals. While there has been a decrease in the number of cases of rabies actually proved to have occurred in the District of Columbia, losses from this disease have been general among the horses, cattle, sheep, and hogs in Virginia and some of the Western States, notably Colorado and Missouri, as a result of bites from rabid dogs and wolves.

An outbreak of rabies among the dogs at Rochester, N. Y., in which at least one authentic case of rabies in man occurred, necessitated

stringent measures by the city health authorities in order to suppress the outbreak. Inoculation experiments at this laboratory proved conclusively that the person mentioned had died of rabies, and also that one of the dogs, the head of which was forwarded from Rochester, was suffering with this disease at the time of its death.

In the stock yards of St. Joseph, Mo., the disease appeared among a shipment of cows which were known to have been bitten some time previously by a rabid dog, and which were held at the stock yards for observation. Four of these animals died with symptoms of furious rabies, and the diagnosis was confirmed by inoculation experiments made in this laboratory. Further investigations proved that a number of other domesticated animals had died, with characteristic symptoms of rabies, in the neighborhood from which the cows were shipped.

From the District of Columbia there were received 60 dogs which had been killed as being suspected of rabies. Of these, 15 were proved to have been affected with the disease at the time of their death. It is known that 5 of these dogs had bitten one or more people. These people were notified of the results of the inoculation experiments, in order that they might take the necessary precautions to prevent the development of the disease. Three of these dogs were also known to have bitten cattle, horses, or other dogs.

The health authorities of the District of Columbia also forwarded the dead bodies of 2 cats, 1 of which proved to have been affected with rabies.

TUBERCULOSIS.

Experiments for the eradication of tuberculosis from the dairy herd at the insane asylum at St. Elizabeth, District of Columbia, have been continued, and all the reacting animals have, by this time, been destroyed and replaced with tuberculin-tested cows. The new herd, now consisting of 115 milch cows, will shortly be submitted to a final test in order to ascertain whether any of the purchased animals have developed tuberculosis since they were admitted to the barns of the asylum.

Inoculations on guinea pigs with milk from the reacting cows, in order to test its infectiveness, have developed results of such a nature that it has been considered advisable to repeat them on a smaller scale before the results are published. It may, however, be mentioned that the results are strongly indicative of the frequent occurrence of tubercle bacilli in the milk of cows which have reacted to the tuberculin test, but which do not show clinical symptoms of the disease.

EXAMINATION AND DIAGNOSES OF PATHOLOGICAL SPECIMENS.

In the course of meat inspection, as carried out by the Bureau of Animal Industry, it frequently occurs that inspectors encounter pathological conditions which even the most trained eye fails to recognize. In a majority of cases the inspectors have neither facilities nor time for histological or bacteriological investigations, and it has, therefore, become customary to forward rare or interesting pathological specimens to this division for diagnosis or for confirmation of diagnoses made by the collectors. During the past fiscal year no less than 344 such pathological specimens were received at this division and the great majority of these were collected and forwarded by members of the inspection division. In all cases where possible the specimens

were treated and preserved according to Kaiserling's method, and the anatomical preparations were added to the pathological collection of this division. At the same time the various tissues were hardened, sectioned, stained, and mounted, and the collector notified of the diagnosis made upon microscopical examination. In this manner more than 2,000 permanent preparations have been made and preserved for future reference.

A great number of pen-and-ink as well as water-color sketches have also been made of the anatomical as well as the histological appearances of the specimens, for the purpose of publication with a series of notes upon comparative pathology with special reference to meat inspection. A great deal of this material is now on hand and will be published with as little delay as possible.

DISEASES OF POULTRY.

Of all the various classes of domesticated animals, there is probably none which suffer to the same extent from infectious and contagious diseases as do the domesticated fowls. A number of diseased or dead fowls were received during the past year for diagnosis and advice as to treatment and prevention. An outbreak of an acute and very fatal disease among a large flock of thoroughbred Plymouth Rocks, in northern Virginia, is of special interest. As the disease differed from all those hitherto described, a thorough investigation was made both at the premises where the outbreak occurred and in this laboratory, and a bulletin containing the preliminary notes on an outbreak of apoplectiform septicæmia in chickens, caused by a highly virulent nonpyogenic streptococcus, has been prepared and is now ready for publication.

All the other specimens forwarded were recognized as originating from outbreaks of diseases, the nature and cause of which are more or less well established, and the owners were furnished with information as to the proper means of treatment and prevention.

Under this heading may also be mentioned an epidemic eye disease which prevailed among the crows in the District of Columbia and surrounding country during the past winter. In certain localities great numbers of crows were found dead or dying, all of them exhibiting symptoms of suppurative keratitis and conjunctivitis. An investigation led to the discovery of a small microorganism as the probable cause of this disease, but, on account of failure to obtain healthy crows for experimental purposes, the investigation was not brought to a satisfactory conclusion.

SKIN DISEASE IN HORSES.

During February last attention was called to a skin disease prevailing among the horses on the Umatilla Indian Reservation at Pendleton, Oreg., and specimens of hide of the affected animals were forwarded to this division for diagnosis. As several thousand horses were said to be affected with this disease, it was of importance that a diagnosis be made, and means suggested for its eradication. The probable causative agent was found to be *Sarcoptes* complicated by the presence of a vegetable fungus which has never hitherto been known to possess pathogenic properties. A bulletin has been prepared on the subject and will be published at the conclusion of a series of experiments which are now being undertaken with a view to finding a remedy for the disease.

LOCUST FUNGUS.

During the past year the Division of Entomology has undertaken a series of experiments for the eradication of locusts by means of fungus cultures, with which the swarms of locusts are inoculated. This division has cooperated in this work by preparing more than 200 tubes of these cultures for the Division mentioned.

GLANDERS.

It has devolved upon this division to prove or disprove, by means of inoculation experiments, the diagnosis of glanders among the horses and mules of the War Department which are stationed at St. Asaph, Virginia, after they have been submitted to the mallein test. In all cases where decided reaction has occurred the diagnosis has been confirmed, and the same has been the case with a number of mules which showed a doubtful reaction. Material from an outbreak of glanders near Ames, Iowa, was also referred to this division and the diagnosis confirmed.

FIELD INVESTIGATIONS.

Salt-sick among the cattle in Florida.—During April last an attempt was made to investigate a disease known as salt-sick, or salt-sickness, which is reported to prevail to a considerable extent among the cattle of central and eastern Florida. The time selected was, however, inopportune and no typical specimens of the disease were obtained for examination. From the information gathered it seems probable that the disease is chronic Texas fever, aggravated by malnutrition and tick-worry. If, however, another opportunity presents itself the investigation will be continued this coming winter.

Spinal meningitis.—A number of outbreaks of this disease have been reported from eastern Maryland and Virginia, and in three cases an inspector from this division was sent to the infected districts in response to urgent requests. In no case has it been possible, however, to obtain typical cases for investigation, as the animals affected had either died or recovered by the time the inspector arrived.

THE EXPERIMENT STATION OF THE BUREAU.

HOG CHOLERA AND SWINE PLAGUE SERUM.

The investigations concerning swine diseases, which have been conducted at the experiment station for several years, were continued throughout the year. Fully as much attention was given to the preparation of an antitoxic blood serum for the treatment and prevention of hog cholera and swine plague, as in former years, and some progress was made in reducing the price for which the serum can be manufactured.

EXPERIMENTS IN IMMUNIZING AGAINST HOG CHOLERA AND SWINE PLAGUE.

In addition to the serum work, extensive experiments were made to find a method for immunizing against hog cholera and swine plague without the use of an antitoxine animal. This work has not yet given satisfactory results, but further experiments with this end in view have been planned. One of the great obstacles encountered in these

investigations is the uncertainty with which a proper exposure can be obtained for treated hogs and accompanying control animals. Subcutaneous injections of apparently virulent pure cultures of hog-cholera and swine-plague germs rarely produce anything more than a local inflammatory condition. Attempts to produce disease by feeding the viscera of hogs which have died of hog cholera or swine plague have failed in all but one instance in our recent work at the station, and, in the case of the exception, the disease was of a very mild chronic character. It is quite possible to kill hogs by injecting cultures directly into their circulation; but by this method death is caused rather by a toxæmic overpowering of the entire organism than by an affection at all resembling hog cholera or swine plague, and hence it is questionable whether it can be used advisedly as a test for any system of immunization.

TETANUS.

No cases of tetanus occurred at the station during the year. The antitetanic serum which is prepared at the station is regularly and successfully used to immunize all the animals which, owing to their condition and the work in which they are engaged, are liable to become affected with tetanus. The two horses which supply the serum have gradually been worked up to a state where the one can bear 1,200 cubic centimeters and the other 1,550 cubic centimeters of tetanus toxine at a single injection. This toxine is so virulent that a fraction of a drop on subcutaneous injection kills a guinea pig within twenty-four hours. The antitetanic serum will be tested for its curative value as soon as an opportunity presents itself.

A peculiar effect of the tetanic serum, when used in immunizing doses, has been observed on some cattle. These cattle, within an hour after receiving an injection of from 10 to 15 cubic centimeters of the serum, begin to show edematous enlargements about the eyes, lips, nose, vulva, and rectum. The parts at times swell enormously. The intensely stretched skin over the vulva and rectum assumes a glistening appearance and looks as if the extreme tension would cause a rupture. At times the skin of the neck and abdomen is also affected and is covered with elevations resembling the appearance present in urticaria, or nettle rash. The symptoms disappear after ten or twelve hours, and the recovery of the animal is complete. An effort has been made to determine whether the swelling is due to the antitoxine of tetanus or to something normally present in the blood serum of the horses. The question has not been finally settled, and will receive more attention in the future.

TEXAS FEVER AND TICKS.

Several minor investigations concerning Texas fever were undertaken and are still in progress. Along with other work of this kind a number of ticks were secured through the division of zoology from different countries which are plagued with ticks and a disease similar to or identical with Texas fever. These ticks from Egypt, Cape Colony, Brazil, Australia, and the West Indies are now being cultivated to obtain good specimens for study and comparison with the North American tick, which acts as the transmitting agent of the infectious material of Texas fever.

Little or no progress has been made in the search for a reliable dip to destroy ticks on cattle. A number of new dips have been tested

and found unsatisfactory. Reports from several sources indicate that the ticks can be affected by substances given internally to the cattle on which they are parasitic, but tests of such substances have given no encouraging results at this station. This entire question will receive further attention in the future.

Toward the end of last summer the cattle ticks in the tick fields had become so numerous that it was necessary to spray the fences and adjoining ground every few days, and even with this precaution the cattle in the fields near the tick fields could not be kept altogether clean. In some instances the young ticks crawled from 20 to 30 feet along the ground and up the sides of fences and buildings, where they collected in clumps of several thousands each. Ticks from these clumps in elevated positions could easily be blown considerable distances by moderately strong winds. The solution used for spraying consisted of tar, carbonate of soda, arsenic, and water. It was very effective in destroying the young ticks which had not become attached to a host, but it killed less than 75 per cent of the ticks of all sizes on the cattle which were dipped in it.

An interesting occurrence in connection with the tick experiments was the accidental presence of the parasites on two kittens, which were confined in a small house in the tick field. The house also contained a number of guinea pigs, which remained perfectly clean. The ticks developed very slowly on the kittens, and the latter unfortunately died before any of the ticks matured. The extreme irritation of the skin and the loss of blood were largely responsible for the death of the kittens.

EXPERIMENTS WITH RABIES.

A number of animals reported to have been bitten by rabid dogs were received at the station, and were kept in confinement and under observation.

Several experiments regarding rabies were made in conjunction with the pathological division. One horse which was bitten and some sheep which were inoculated with material from rabid animals succumbed to the affection after showing characteristic symptoms.

OTHER WORK.

Some work was done in connection with the antitoxine experiment to determine the loss in the number of red-blood corpuscles as the result of frequent blood drawings, and the rapidity with which the animal's system is able to correct the loss by the formation of new corpuscles. Time was also given to a study of the character of the newly formed corpuscles, and to the possible modifications in the number and character of the white corpuscles of animals which receive periodic injections of septic material. Investigations along this line will be continued as time will permit.

Animals and facilities were provided the division of zoology for the further investigation of the sheep-scab question, and to test various drugs for the removal of parasites from the stomachs and intestines of sheep and hogs.

The pathological division was provided with animals and facilities for the investigation of the following diseases: Braxy and pseudotuberculosis in sheep, vulvitis of cattle, and an infectious disease among the cattle of a local asylum. A number of specimens of black-leg vaccine were also tested for the same division on sheep and guinea pigs.

Cattle and hogs were provided for the biochemic division for special experiments concerning hog diseases, and these animals were treated with material prepared by the division in accordance with instructions accompanying such material.

As in former years, a large number of small animals for experiment purposes were raised at the station and used or forwarded to the laboratories as occasion required.

Several new buildings were constructed, much necessary fencing and refencing was done, and the water system improved and extended. A fairly successful attempt was made to raise a supply of green feed for small experiment and breeding animals. Work of this kind makes excellent returns for the time and thought given to it, and it is to be regretted that the area of ground which is available for cultivation is limited to less than 1 acre.

The need for additional land is constantly and urgently felt. On a total of 20 acres, much of which is occupied by buildings, roadways, outdoor experiment cages and quarantine pens, the following animals, employed in widely different experiments, together with the facilities for handling them and keeping the various infections under proper control, are collected:

(1) A herd of 72 antitoxine animals, consisting of horses, mules, cattle, and donkeys, for supplying hog-cholera, swine-plague, tetanus, and two kinds of tubercular serum.

(2) Several animals, a horse, cattle, and donkeys, for supplying normal serum for a variety of purposes.

(3) A herd of a dozen or more cattle either affected with tuberculosis or being employed in experiments concerning this disease.

(4) A flock of 50 or more sheep, subjects of investigations concerning sheep scab, foot rot, blackleg, pseudo-tuberculosis, true tuberculosis, and various internal animal parasites.

(5) Half a dozen cattle used in Texas-fever investigations.

(6) Cattle on which at least half a dozen different varieties of ticks are being grown, all of which must be kept well separated and under conditions which will prevent the ticks from getting on any animals except those which are intentionally infected.

(7) A small herd of cattle used in tick-dipping experiments.

(8) About a hundred hogs, in special hog-cholera and swine-plague experiments, in which at least a dozen different bacteria, supposedly pathogenic, are being handled.

(9) Dogs in quarantine and under observation for rabies.

(10) Horses affected with *maladie du coït*.

(11) Goats in special milk work.

(12) Donkeys, hogs, calves, and monkeys, and several kinds of smaller animals in special tuberculosis investigations.

(13) A collection of brood sows, for producing young pigs for special swine-disease investigations.

(14) A number of normal work horses.

Our fields are so small for the animals confined in them that they remain bare of vegetation the entire year and present the appearance of a desert.

DAIRY DIVISION.

A general survey of the condition of the dairy industry of the country at large was begun upon the organization of the dairy division. This has been continued and special inquiries have been made,

such as the status of dairy organizations, dairy schools and facilities for technical instruction, State dairy laws, the development of foreign markets for the dairy products of this country, the milk supply of cities and towns, and laws and ordinances relating thereto. Some reports have been printed and others are in course of preparation.

As heretofore, attention is given to the collection of dairy data in general, with a view to its proper arrangement and future use. So far as the clerical force of the office permits, the material collected has been indexed for ready reference. Although necessarily much in arrears, this catalogue of dairy information is of great value and in constant use.

The routine work of the office is constantly increasing. This embraces current correspondence, with many requests for specific information from all parts of the country, and the preparation of reports and other manuscripts for publication. During the year the division has prepared four distinct publications for distribution, comprising in all 188 printed pages; most of these were liberally illustrated from original photographs obtained for the division or made by its officers. One of these reports was published in the Yearbook for 1900 and two in the current Annual Report of the Bureau, all being separately reprinted.

The chief and assistant chief of the division have visited dairy centers in ten different States and attended conventions of dairy associations and similar bodies in four of these. Rather less has been done along this line than in previous years—first, because of discontinuing the plan of employing persons for this representative service who are not regularly connected with the Department, and, second, because of the time occupied in giving attention to more distant fields of interest.

The new insular possessions of the United States and thirteen foreign countries have been visited during the year by officers or special expert agents of the division. The investigations thus made have embraced the most interesting dairy producing districts of Great Britain and western Europe and the markets of Japan, China, Canada, Cuba, and St. Thomas. Materials have been thus collected for special reports now in preparation and others to be made later.

Experimental exports of dairy products from the United States, similar to those of previous years, have been made to Great Britain, to France (in connection with the Paris Exposition), to Japan, China, Cuba, and Porto Rico. It has been well established that our market for cheese in England and Scotland can be largely and profitably increased by judicious management. Butter from this country can find a place in the British markets at almost any time in successful competition with the best product of other countries, provided our surplus production affords a regular supply and the prices offered become a sufficient inducement to exporters. Occasionally at irregular periods, and owing to special and temporary conditions, American butter can be sold to advantage at Hamburg and at Paris. No other market has developed on the Continent of Europe favorable for butter from the United States. In Cuba, Porto Rico, and other points in the West Indies there are opportunities for increasing the sales of dairy products from this country. A special report upon this subject will soon be submitted. In Japan and China some openings for new trade are being found, but active Australian competition must be met. It is rather too early to express definite opinions on this subject, but

it now appears necessary to raise the quality of Pacific coast products, improve methods of packing and preserving, and obtain more satisfactory ocean transportation facilities before any considerable demand can be created in the Orient for the dairy products of the Pacific States.

Incidental to the experimental exports, fine exhibits of dairy products of the United States were made at the Universal Exposition at Paris and the annual show of the British Dairy Farmers' Association at London (October, 1900). These displays were personally supervised by the chief of the dairy division, and the duties connected therewith required much labor of detail at the office of the division. A report upon the dairy features of the Paris Exposition has already been submitted and published.

During the fiscal year 1901-1902 the work of the dairy division is expected to be largely a continuation of that of the year previous, as above reported.

The investigations of productive conditions, demands of consumption and markets, made in Porto Rico and other West Indian islands by Mr. Pearson, assistant chief of the division, and in the Orient by Mr. Emery, special expert agent, will be completed and reported upon. Further experimental exports are likely to be made, based upon these reports.

Incidental to these endeavors to supply butter and cheese to markets in warm climates, and requiring long voyages without refrigerated transportation, it will probably be found necessary to make a careful study of the whole subject of preparing and packing butter for distant markets and long keeping, with exposures to high temperatures. In the same connection, further investigation of the means of producing good butter having a high melting point and comparatively resistant to high temperature in transit and in market is necessary.

More attention is being given every year in this country to the manufacture of cheese of foreign forms and peculiarities. Information on this subject is called for and another field of labor for the division is thus indicated.

Material improvements are in progress in the milk supply of cities and towns. The dairy division hopes to follow this important subject closely, and to contribute to the means and methods of attaining the desired advance in the purity and quality of market milk.

In accordance with repeated recommendations from this office, approved and embodied in successive Annual Reports of the Bureau and the Department, the Congress at its last session amended the act of 1891, which provides for the inspection of live cattle, the carcasses and products thereof, to include all dairy products offered for export, in order "to secure their identity and make known in the markets of foreign countries to which they may be sent from the United States their purity, quality, and grade." This new law becomes operative with the beginning of the fiscal year of 1901-1902, and it is assumed that considerable work of administration and supervision will devolve upon the dairy division in this connection.

As collateral to the work of this division it is hoped to conduct during the year a very full analytical examination of the various dairy products of foreign countries. Samples for this purpose have already been collected and will be greatly added to from the products found by officers and agents of the division at the foreign exhibitions and markets visited.

Some cooperative labor will be expected of the division in the course of the year under the arrangements already made with the Census Bureau for criticising and verifying the statistics of dairying in the Twelfth Census of the United States.

THE ANGORA GOAT INDUSTRY.

During the last three or four years requests for information about Angora goats have been received in increasing numbers. These requests finally became so numerous that a bulletin was issued on the subject under the title of "Information concerning the Angora goat." This bulletin contains 94 pages, 17 plates, and 1 text figure, and was designed to give answers to all the questions that are asked of the Bureau. But the demand for it was great and stimulated a desire for further information, especially regarding available land and names of breeders and dealers in mohair, subjects which could not properly be discussed in the bulletin. This has operated to increase rather than diminish the correspondence.

Angora goat raising is in fact a rediscovered industry in the United States. For a score or more of years these goats have been raised in large numbers in Texas, New Mexico, California, and Nevada, and there has always been a ready market for their mohair; but it is only quite recently that their ability to clear land of brush, briars, and weeds has become generally known throughout the country. Now that the fact is well known, there has been a great demand for these goats in those sections of the country which are suffering from the encroachment of brush and briars upon the farm and pasture lands. They have found their way into every State in the Union, as well as into Canada and Alaska.

Assured as we are that the Angora will produce an annual fleece which is worth from \$1 to \$1.50; that it will destroy the brush, briars, and weeds on abandoned land, permitting the grass to follow; that its flesh is as palatable and as nutritious as that of the sheep; that its skin with the fleece attached is worth from \$1.50 to \$2.50—it would seem that Angora goat raising is certain to develop into a permanent industry.

A Farmers' Bulletin on "The Angora goat" will soon be issued, besides the bulletin mentioned above, and the Bureau will from time to time publish such additional information as may come to hand.

EXHIBIT AT THE PAN-AMERICAN EXPOSITION.

The duty of suitably representing the work of the Bureau of Animal Industry at the Pan-American Exposition at Buffalo May–November, 1901, was intrusted to Mr. E. B. Jones, assistant chief of the inspection division. Although the space and amount of money allotted to the Bureau were both inadequate, a comprehensive display of the various branches of its work was made. The idea was to show, as well as the means permitted, what the Bureau is doing, both scientifically and practically, for the benefit of the farmer, stock raiser, and consumer of animal products.

A list of the various features comprising its exhibit, prepared for the use of the officials of the exposition, gives a condensed description, and is printed here in preference to a more detailed statement. A complete list of the titles of every article shown would be superfluous.

Series 1 illustrates the meat-inspection work of the Bureau.

- (a) Practical demonstration of the microscopic inspection of pork for trichinæ. Three assistant microscopists are engaged in examining samples of pork from one of the official abattoirs. A specimen of pork containing trichinæ is under a microscope, arranged for the inspection of visitors.
- (b) Plaster life-size models of a half of a beef carcass, a carcass of mutton, and a hog carcass to show how they are branded after having been inspected and passed as wholesome.
- (c) Articles used in the inspection of meat and live animals, such as tags, brands, seals, sealing presses, stamps, certificates, sample boxes, compressors, etc.
- (d) Photographs of the ante-mortem and post-mortem inspection of cattle.

Series 2 illustrates how cattle are inspected and tagged prior to exportation, the manner of loading animals upon the vessels, and the way in which vessels are fitted to secure the safe and comfortable transport of animals to foreign countries.

- (a) Model of part of stock yards, showing the employees of the Bureau of Animal Industry engaged in inspecting and tagging cattle for export.
- (b) Model of section of cattle-carrying steamer and pier and stock car. This shows how cattle are loaded from cars into steamer and how they are stowed on board, and the character of the fittings required on vessels engaged in the cattle-carrying trade.
- (c) Photographs showing the inspection and tagging of cattle for export, the loading of a steamer with cattle and horses, and views of the decks to show the fittings on a modern cattle steamer.

Series 3 illustrates the cause and appearance of the disease known as sheep scab or scabies in sheep, and the spread of which is largely prevented by dipping in a preparation which kills the parasite. The method of dipping is well shown by models and photographs.

- (a) Models of sheep-dipping plants, showing how sheep are dipped for the prevention of scabies. Two forms of vat are illustrated.
- (b) Two mounted sheep, illustrating the effects of scabies, one in the early stages of the disease, the other in a more advanced condition.
- (c) Two wax models, greatly enlarged, of the male and female parasite causing the disease of scabies in sheep.
- (d) Photographs of sheep-dipping scenes.

Series 4 gives photographs of Angora goats: Views of individuals and groups, pasturage, effect of "goating" on brush land, degrees of fineness in mohair, etc.

Series 5 refers to Texas-fever work.

- (a) Calfskin, to which are affixed wax models of the Texas-fever tick. This is to show the appearance of the ticks and the way in which they attach themselves to cattle, selecting the more tender and protected parts on the under side of the body.
- (b) Maps showing the part of the United States infected with Texas or splenic fever in cattle, one map containing the entire area, others showing sections on a larger scale.

Series 6 is a very complete exhibit of the horse's leg, foot, and shoe—the anatomy of the leg and foot; samples of feet, illustrating various abnormal conditions affecting them; the result of improper shoeing; how to correct abnormalities by using proper methods of shoeing; various kinds of shoes, and horseshoeing tools.

Series 7 illustrates the work of the laboratories of the Bureau of Animal Industry in the investigation of the causes and means of prevention of animal diseases.

- (a) Working laboratory, fitted with all the necessary apparatus for investigations in pathology, bacteriology, and zoology.
 - (b) Model of chute used for vaccinating calves against blackleg, and also for dehorning them.
- Blackleg virus and vaccine.

- (c) Plaster and wax models of diseased animal organs, to illustrate the lesions found in various diseases.
- (d) Specimens of tissues and organs in preserving fluid, showing the lesions of different diseases affecting animals.
- (e) Cultures of pathogenic bacteria.
- (f) Specimens of animal parasites, preserved in alcohol.
- (g) Products of bacteria, toxins and antitoxins, mallein and tuberculin.
- (h) Case of 60 transparent photographs, showing tissues and organs affected with various diseases, magnifications of slide preparations of pathogenic micro-organisms, and enlarged views of animal parasites.

Series 8 illustrates the dairy exhibit.

- (a) Composition of milk and its products; one gallon of milk and its component parts; one tub of butter (10 pounds) and its component parts; one cheese (10 pounds) and its component parts.
- (b) Samples of the commercial forms of the by-products of the dairy, and articles showing their application.
Casein, albumen, and milk sugar, with their commercial forms and applications, illustrative of the economic uses of the by-products of dairying.
"Nutrium," the non-fatty solids of milk, in a pure, dry, imperishable form, but soluble and digestible, for use as a human food, and especially in baking and bakery products, illustrative of the economic uses of the by-products of dairying.
- (c) A complete collection of modern cans, models, bottles, buckets, brushes, etc., both domestic and foreign, which are essential to clean dairying.
A large collection of milk cans and dairy hardware, good material and workmanship, with consequent efficiency and durability.
Models and material illustrative of methods and appliances for a pure, sanitary milk supply.
- (d) General collection of commercial packages for milk and butter, of most approved forms, in use in the United States and foreign countries, showing advancement of the market features of the dairy industry.
- (e) Collection of 34 models illustrating foreign forms of cheese.
- (f) Photographs of model dairies.

REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., September 1, 1901.

SIR: I have the honor to submit herewith a report on the organization and work of the Bureau of Plant Industry for the year 1900-1901.
Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON, *Secretary.*

ORGANIZATION.

With a view to carrying out the general policy outlined in your last Report in regard to the affiliation of allied lines of work, the Office of Plant Industry was organized in accordance with an order issued by you in October last. The bringing together of the related lines of work was accomplished with perfect harmony, and the advantages of the union soon became apparent. As a partial result of this movement it was seen that the time was ripe for a general reorganization of the Department along the lines laid down by you in your last Report, namely, "The aggregation of related branches in such a way as to give the broadest opportunity for the development of all." In accordance, therefore, with your recommendation to Congress, the Bureau of Plant Industry was organized as one of four new Bureaus, and on July 1, 1901, the law authorizing the necessary changes went into effect.

The Bureau as now constituted consists of the following principal offices: Chief of Bureau; vegetable pathological and physiological investigations; botanical investigations and experiments; grass and forage plant investigations; pomological investigations; experimental gardens and grounds; Arlington experimental farm; investigations and experiments in the production of domestic tea; foreign seed and plant introduction; and the Congressional seed distribution. Besides the chief, the other executive officers of the Bureau are Albert F. Woods, in charge of vegetable pathological and physiological investigations and acting chief in the absence of the chief; Frederick V. Coville, in charge of botanical investigations and experiments; F. Lamson-Scribner, in charge of grass and forage plant investigations, and Gustavus B. Brackett, in charge of pomological investigations. To further facilitate the investigations of the Bureau, the several offices have been subdivided, and responsible men have been assigned to direct the details connected with each line of work. Following out this plan, the vegetable pathological and physiological investigations are con-

ducted under Mr. Albert F. Woods by the following officers: Erwin F. Smith, pathologist, in charge of the laboratory of plant pathology; Walter T. Swingle, physiologist, in charge of the laboratory of plant physiology; Herbert J. Webber, physiologist, in charge of the laboratory of plant breeding; Newton B. Pierce, pathologist, in charge of Pacific coast laboratory; Hermann von Schrenk, special agent, in charge of Mississippi Valley laboratory; Peter H. Rolfs, pathologist, in charge of subtropical laboratory; Merton B. Waite, pathologist, diseases of orchard fruits; Mark Alfred Carleton, cerealist; C. O. Townsend, pathologist; George T. Moore, physiologist; B. M. Duggar, physiologist; Rodney H. True, physiologist; William A. Orton, assistant pathologist; Joseph S. Chamberlain, expert in physiological chemistry; Thomas H. Kearney, assistant physiologist; Cornelius F. Shear, assistant pathologist; Flora W. Patterson, mycologist; R. E. B. McKenney.

The botanical investigations and experiments, under Mr. Frederick V. Coville, are in the hands of the following: O. F. Cook, tropical agriculture; A. J. Pieters, pure seed investigation and seed laboratory; V. K. Chesnut, investigations of poisonous plants; Lyster F. Dewey, fiber investigations and assistant botanist; Carl S. Scofield, cereal exports.

The investigation of grasses and forage plants, under Mr. F. Lamson-Scribner, is conducted by A. S. Hitchcock, in charge of field work; David Griffiths, in charge of field management; Elmer D. Merrill, in charge of collections; C. R. Ball, assistant agrostologist.

The Pomologist, Mr. G. B. Brackett, has as his principal officers William A. Taylor, in charge of field investigations; H. P. Gould, in charge of fruit district investigations, and George C. Husmann, in charge of grape investigations.

The work of the experimental gardens and grounds, the Arlington experimental farm, investigations and experiments in the production of domestic tea, foreign seed and plant introduction, and the Congressional seed distribution are conducted by the office of the chief of the Bureau with the following staff: L. C. Corbett, horticulturist; Edwin M. Byrnes, head gardener; George W. Oliver, expert, gardens and grounds and experimental farm; Dr. Charles U. Shepard, tea growing; Ernst A. Bessey, foreign seed and plant introduction; David G. Fairchild, agricultural explorer; Robert J. Whittleton and James Morison, Congressional seed distribution.

In bringing about the organization as here outlined, the fact has been kept constantly in mind that the strongest growth and greatest development can come only through a proper recognition of the necessity for maintaining the integrity of the various related groups. Our policy is to give the broadest opportunity for each branch of work, to unify the various interests, and to bring about a spirit of harmony and friendly rivalry stimulating to all. The results fully justify the statement that nowhere will be found a more united organization and a more earnest desire on the part of each officer to make his work second to none of its kind in the world.

A number of changes have been made in handling the work of certain auxiliary branches of the Bureau which have resulted in advantages to all. Thus, in the case of the experimental gardens and grounds the opportunity is now afforded all branches of the Bureau to have access to the greenhouses and grounds and to utilize to the fullest extent the facilities at hand for carrying on investigations where special facilities are required. The Arlington experimental

farm will also be made not only an auxiliary branch for the Bureau, but as far as possible for the whole Department. As yet the entire work on the farm has been confined to necessary preliminaries, such as clearing, draining, and putting the ground in condition for practical work.

A change has been made in the management of the work of foreign seed and plant introduction. The work is now conducted with a view to making it beneficial to all branches of the Bureau. The plan adopted with respect to this work puts special matters pertaining to seed and plant introduction into the hands of responsible officers already in the Bureau. These officers have been charged with the work of introducing, disseminating, and following up the development of new crops, with, it is believed, the promise of very satisfactory results. The cereal introduction, for example, has been placed in the hands of Messrs. Carleton, Swingle, and Scofield, while the introduction and dissemination of new varieties of cotton will be looked after by Messrs. Webber and Dewey. Mr. Fairchild will be charged with the care of certain special crops, while other members of the Bureau will have similar responsibilities. This plan makes it possible to concentrate work in such a way as to assure the best promise of success. All plans for the future with respect to this work are made with a view of concentrating efforts on furnishing new crops, and following up these efforts until success or failure is assured. The result of this policy is given in detail under another head.

COOPERATIVE WORK.

It has been the general policy of the Bureau to bring about as close cooperation with other branches of the Department and with the State experiment stations as is possible under existing conditions. Fortunately, the past year has brought about changes which make cooperation far more feasible than heretofore. The Bureau is now cooperating with the Bureau of Soils, the Bureau of Forestry, and the Bureau of Chemistry in important lines of investigation. In addition, extensive cooperative work is under way with the State experiment stations, all of which is described elsewhere in this report. True cooperation is always helpful, and our aim has been to recognize as fully as possible the fact that a clear understanding at the outset of what is expected of each party to the work is essential to success.

CHANGES IN PUBLICATIONS.

The growth of the Department during the past few years has led to much confusion in the matter of publications. The number of series of bulletins, circulars, Farmers' Bulletins, etc., has increased so rapidly that it has been difficult to keep track of the various changes made. In order to secure uniformity in the publications of the Bureau as far as possible, plans have been made and put into effect whereby all bulletins by the different branches will be issued as one series. This will greatly simplify matters, and will do away with much of the confusion that now exists. In addition to the one series of bulletins, the Bureau will issue circulars, Farmers' Bulletins, and Yearbook papers. The three last named will be for widespread distribution, and will aim to emphasize the practical phases of all branches of the work.

REPORTS OF EXECUTIVE OFFICERS.

Following are the reports of the several executive officers of the Bureau on the work of their respective branches:

REPORT OF THE PATHOLOGIST AND PHYSIOLOGIST, ALBERT F. WOODS, ON WORK OF THE YEAR.

CEREALS.

The experience of the cerealist in charge of the Department's investigations of cereals, in his trip to Russia and other European countries and in connection with the installation of our exhibit and the jury work at the Paris Exposition, has proved to be very valuable to the Department in its cereal work. A careful survey of the cereal industries of the United States has been made and a report published, in which the problems most needing attention are set forth clearly and concisely. This report has not only proved a very valuable foundation on which to plan our future investigations, but is of great value to those engaged in similar lines of work.

Russian wheats.—The hardy winter wheats imported from Russia have proved so successful that the growers of Kansas have recently imported privately over 15,000 bushels of the Crimean wheat for seed. Still other and harder Russian wheats are being tested, and will, it is believed, supplant the spring wheats in Iowa, Nebraska, and northern Kansas, and increase the yield in these States probably over 5 bushels per acre. Some valuable drought-resistant Russian wheats which have been tested by the Department show that they are admirably adapted to the region west of the 100th meridian, where wheat growing is uncertain or practically impossible. In connection with the Office of Seed and Plant Introduction we expect to introduce a large number of very promising Russian wheats specially adapted to some of our wheat-growing areas. In all this work disease resistance is kept in mind and some sorts remarkably free from rust have been obtained.

Nonshattering wheats.—A few years ago Jones Winter Fife wheat was tested in Washington State and yielded remarkably well, but the crop could not be saved because of shattering. This variety is therefore being crossed with nonshattering varieties, and the hybrids obtained will undoubtedly produce a nonshattering grain that will yield well in the region in question.

Macaroni wheats.—The tests of the different varieties of macaroni wheats which have been recently made by the Department indicate that several of the finest varieties of these can be produced in the drier portions of the country, from Texas to North Dakota. Notwithstanding the severe drought of the past season, these wheats yielded heavily. The interest that has been aroused in the growing of these wheats and in milling them has been phenomenal, and every endeavor has been made to furnish growers and millers with the necessary information in regard to them. The United States imports annually over \$16,000,000 pounds of macaroni, and the establishment of the industry in this country will doubtless lead to the production of thousands of bushels of macaroni wheats on lands where ordinary wheats can not be produced. Efforts to develop foreign and domestic markets are yielding satisfactory results, and it is the belief that we will soon produce better macaroni than that obtained abroad. Our manu-

facturers are rapidly realizing the advantage of using these wheats for macaroni in preference to the ordinary bread wheats, and are now ready to take practically all that can be grown this season. A circular on the subject has been published and a report is now in course of preparation. During the current year a large quantity of these wheats will be imported in connection with the Office of Seed and Plant Introduction, and much attention will be given to establishing the macaroni industry on a firm basis and testing new varieties.

Emmer.—Another crop for semiarid regions to which the Department is calling attention is a food for stock called emmer. This crop is a heavy yielder, and seems to do well where most other crops would perish from drought or cold. A Farmers' Bulletin on the subject is now in press.

DISEASES OF FRUITS.

Bitter rot of apples.—The losses caused by bitter rot in the Middle States often amount to half or three-fourths of the entire fruit crop, single large growers sometimes losing 10,000 barrels of apples. One firm estimated that their losses in 1900 on apples bought in the orchard in Missouri alone amounted to \$20,000 to \$30,000, and orchards which in midsummer promised a yield of 25,000 barrels of choice apples produced only about 5,000 barrels of indifferent fruit, owing to this disease. The president of the National Apple Shippers' Association estimated that the damage to the apple crop of the United States in 1900 from bitter rot was \$10,000,000. These enormous losses have led us to renew our investigations of the disease, and extensive experiments have been inaugurated this season in Virginia, Illinois, and Missouri to test the efficacy of spraying in preventing this disease. The experiments in Virginia, the only ones on which a report has yet been made, appear to be satisfactory. The work is so important that it will be vigorously pushed next season.

Peach rot.—This disease, caused by the fungus *Monilia*, has been so extremely destructive to the peach orchards of Georgia and Michigan that renewed efforts have been made to find methods of combating it and also to learn more definitely the life history of the fungus. Last summer one grower in the State of Georgia lost his entire crop of 40 carloads of peaches by this disease, and similar losses, representing more or less complete destruction of the crops, were common in the State. In Michigan, too, the losses were very severe, often amounting to one-fourth or one-half of the entire output of whole sections. An extensive spraying experiment was inaugurated in Virginia last spring to test the effect of different mixtures and different dates of spraying both on the peach and the plum, and although this experiment was not as successful as had been anticipated, owing probably to the wet season, the disease was reduced about one-half, and besides some new facts were learned in regard to the life history of the fungus and the resistance of different varieties of fruit. Another important fact brought out is that the rot fungus is distributed by insects—wasps, soldier bugs, and honey bees being prominent in the destructive work. Where the destruction by the rot fungus was extremely severe certain varieties were almost immune, ripening a satisfactory crop alongside of the rotting fruits. The importance of breeding the varieties resistant to the disease will be discussed more in detail under "Plant breeding." While planning these experiments a new device for mixing Bordeaux mixture was invented or perfected.

Black rot of grapes.—In North Carolina and to some extent in adjacent States black rot destroyed the entire crop of Niagara grapes this season and but a very small percentage of the entire crop of grapes matured. A preliminary trip through this region resulted in opening up the question of the efficiency of Bordeaux mixture and the ordinary spraying apparatus in preventing this disease in the South. The coming season a thorough study will be made of the subject to determine why growers in the South fail to control this disease with the treatment which is successful in other parts of the country. Plans have been made for carrying on the work at Southern Pines or Tryon, N. C., or perhaps at both places.

Little peach.—Investigations have been continued on this very obscure disease, and have served to strengthen the evidence of the work last season that the trouble is caused by a minute fungous parasite of the roots. The fungus was found in much larger quantities than ever before, it having increased alarmingly in certain affected localities, and it was also found in fruit for the first time. It does not seem to spread very much to new regions, however. In quite a number of cases orchards affected last year have been totally destroyed the present season. Two methods of dealing with the disease are at least promising—(1) eradication and (2) the securing of resistant stocks. Where growers are on the alert for the disease and promptly pull out and destroy the very first suspected cases their orchards have, almost without exception, remained intact, but where they wait for the trees to ripen fruit and hesitate about prompt removal the disease spreads so rapidly that in three to five years the orchard is practically beyond recovery. As regards resistant stocks, there is but little evidence on this point from our field work, and our conclusion is based entirely on general principles that hold true in the behavior of similar diseases. Although prompt removal indisputably holds the disease in check, we are not satisfied with such a radical line of treatment, and hope by persistent investigation of the life history of the parasite and experiments with resistant stocks to work out some method by which all trees may be saved. An experiment to test the effectiveness of fertilizers and fungicides when applied to soil around the trees will also be made the coming season. Sufficient data on the little peach has been collected to justify the publication of a report at the conclusion of this season's work. While investigating the little peach a number of interesting facts about other peach diseases were gathered and the data will be published during the current year.

Pear blight.—Pear blight has broken out with renewed severity in Texas, and has been extremely destructive to the Bartlett pears growing on the Pacific coast. (See "Work on the Pacific coast.") A visit to Texas in October is planned to test our method of eradicating the disease by cutting out the hold-over blight. The experiment will be continued during next spring.

ROOT ROT OF FRUIT AND OTHER TREES.

The special agent in charge of the Mississippi Valley laboratory has made very satisfactory progress in the study of the root rot of fruit and other trees, a disease which causes immense losses in all the great fruit-growing regions. The parasite which causes it has been found and its life history has been partially worked out. Extensive experiments

have been started, in cooperation with a number of nurserymen, to test the resistance of different stocks to the disease, and a large number of stocks have been obtained for this purpose from Australia and other sources. The results so far obtained give ground for the hope that a method of controlling the disease will soon be worked out, and a special endeavor to do this will be made the coming season.

DISEASES OF FOREST TREES AND CONSTRUCTION TIMBER.

The great revival of interest in forestry and the care of trees has made it desirable that our efforts to furnish information as to the best methods of controlling or preventing some of the most serious diseases of trees be increased. The main results of the year's work were published in two bulletins, one on diseases of the red cedar and one on diseases of New England conifers, and also in a Yearbook paper on general diseases of forest trees, all of which elicited very favorable comment, and for which there has been a great demand. The great annual losses of life and property resulting from the destruction of construction timber by fungi is a matter of much importance, and various tests are under way to determine the best methods of preventing these losses. The expert in charge of these investigations has been sent to Europe to study the methods in vogue there for controlling forest-tree diseases and treating construction timber to prevent the development of rots. The Bureau of Forestry is actively cooperating in the work, and the matter is of such great moment that many railroad and other interests have urged the necessity of enlarging the investigations and have given us material assistance by practical cooperation. The work on all diseases of forest and shade trees and construction timber will be pushed vigorously the current year, and with its development there is every reason to believe that there will be a corresponding decrease in the loss of life and property. A special fund will be required for this important work.

DISEASES OF COTTON.

A great deal of work has been done in connection with the diseases of cotton during the year. It has been found that the wilt disease is much more widespread and destructive than was hitherto suspected, and that the annual losses from it far exceed our former estimate of \$250,000. It is especially destructive in Alabama and Mississippi and in the sea island cotton districts of Georgia and Florida. As a result of the work, it is believed that a practical remedy, or rather preventive, has been found through the selection of seed from healthy or resistant plants growing in infected areas. We have a considerable number of such resistant selections growing, and these will be greatly increased next year. The subject is further discussed under "Plant breeding." A careful study of the root rot of cotton, so prevalent in all Southwestern cotton areas, has been undertaken, and also a study of boll drop, anthracnose, and other serious diseases of the crop. The work will be continued and enlarged the coming season.

WORK ON TOBACCO.

The investigations of tobacco discussed in the former annual report, and carried on in cooperation with the Bureau of Soils, were temporarily suspended, owing to the fact that the expert who was conduct-

ing the work resigned early in the year to accept a more remunerative position in Japan, as stated in our last report. His final work here resulted in the discovery of a new enzym, and a report on this was published, this being his third report on the investigations. The work will now be resumed, two experts having been appointed to carry it on, in cooperation with the Bureau of Soils. It is expected that many valuable facts will be brought out during the current year. The so-called mosaic disease of tobacco was worked out during the year, and a paper in regard to it is now ready for publication. The breeding of new strains of tobacco is discussed under "Plant breeding."

TRUCK AND GARDEN CROPS.

Spraying experiments were carried on during the past year with a view to controlling the tomato blight mentioned in the last annual report and were successful, the work showing that the disease, which causes large annual losses, can be easily and economically controlled. Laboratory investigations of the wilt disease of the cowpea and watermelon were continued. As the former is one of the most important rotation crops of the cotton and truck areas, it is very desirable that we determine whether the method of selection which promises success in controlling the cotton wilt may not also be effective for wilt of this and other crops. The results so far obtained are very encouraging. A similar wilt of cabbage, which is very widespread throughout the South and very injurious, has been studied, and we will probably soon be able to recommend methods of preventing it. A great many diseases of other truck and garden crops have been called to our attention, and it is planned to work out remedies for these also the coming season.

During the year we collected from all parts of the country and from Porto Rico a large number of varieties of sweet potatoes, for the purpose of determining the comparative merits as regards adaptability for shipping, disease resistance, productiveness, etc. Duplicate experiments with the collection are being carried on at College Park, Md., and Tarboro, N. C., in cooperation with the agricultural experiment station and the State Board of Agriculture, respectively. The experiments will be continued and enlarged the coming season, and will include a study of storage and other questions connected with this crop.

GREENHOUSE CROPS.

During the year our investigation of carnations, lilies, violets, and other greenhouse crops has been continued in cooperation with other branches of the Department, watering, feeding, and propagation receiving careful attention. Much valuable information on these subjects has been collected, and it is hoped to bring this together in the form of a bulletin at an early date. The work along these lines will be continued and enlarged. Plans have already been made for carrying on a special study of diseases of the rose.

DISEASES OF THE SUGAR BEET.

The serious sugar beet blight which causes severe losses in California and Colorado, as mentioned in the previous annual report, has appeared to some extent in Nebraska the present season. The results

of the investigations in California, Colorado, Kansas, and Iowa indicate that this particular blight is not of parasitic origin, but that it is due to a lack of sufficient moisture to meet the demands of excessive evaporation from the foliage. Beets affected with this disease become hard and woody and the young feeding roots and taproot are destroyed. An expert pathologist has been appointed to carry on investigations of the diseases of the sugar beet, and his entire time will be devoted to this work during the next two or three years. We are in constant receipt of requests for information in regard to these diseases from all important beet-growing regions. A report on the particular blight above mentioned will be published during the current year.

WORK IN THE PACIFIC COAST STATES.

Bacteriosis of walnuts.—Three lines of work on this disease have been carried on during the year: (1) Extensive spraying experiments for the purpose of preventing the disease in orchards already established. Some of the sprays tested resulted in a large saving of nuts, while others gave no positive results. (2) Selecting from seedling orchards resistant trees, which embody the character of fruit and habit of growth most desired, and from which nursery stock may be budded or grafted. One variety has been found which answers these requirements and others will certainly be obtained when the field can be thoroughly explored. (3) Breeding of resistant varieties, which includes the crossing of hardy varieties of *Juglans regia* and hybridizing this with other species of *Juglans* which appear to be free from the disease. Considerable work in this line has already been done, and as a practical result a hybrid root has been found which has such great hardiness, notwithstanding unfavorable soil conditions, that it will be used as a stock upon which to graft the disease-resisting varieties of *Juglans regia* when selected from the orchards. Its vigor and hardiness are such that it bids fair to increase threefold the possible successful commercial walnut culture of the Pacific coast, and will eventually represent a great financial gain to the industry. The work on bacteriosis will be continued on the lines above mentioned, and a large amount of field work will be necessary in the treatment of groves, the study of the comparative resistance of trees, the crossing and hybridizing of tens of thousands of nuts, the propagation of trees from the nuts obtained from the work of the past spring, the testing and grafting of stocks, etc. This growing and grafting of stocks and hybrids calls for land, and it is hoped that this requirement may be met in some satisfactory way. During the year we hope to make a collection of nuts of all species of *Juglans* and of all well-marked types of *Juglans regia*, so that a direct comparison may be made of the varieties, and that the different wild species may be on hand for the hybridizations planned.

Pear blight.—This bacterial disease of pomaceous fruits has now become well established in many parts of California and the North Pacific States. It has been found that the infection of fall bloom and the tender growth at the base of the main limbs has resulted in the death of more trees in California than is caused by the common spring infection. By preventing such bloom and growth from developing at the base of the main limbs, where it is not required for the production of fruit, a leading source of the infection of the more vital parts of the tree is removed. As the disease is prevalent in orchards where colonies of bees are kept in the vicinity, it has been

agreed by owners of large colonies to remove them to a distance of 5 miles from the orchards during the season of bloom, which in California is largely synchronous with the season of growth. This experiment, which will be made the coming season, should supply data for future action, and in order to collect it records of several orchards will be made in a comparative way to show the number of infections before and after the removal of the bees. This work will have to be done on a large scale and continued through several years. It is also proposed to shortly determine the identity or nonidentity of pear blight and the new blight of the loquat, the bacterial nature of the latter being already known.

Tuberculosis of the olive.—This destructive disease has been studied in both the field and the laboratory during the past year, and the work has led to the conclusion that the disease may be practically controlled in the State, and that naturally resistant varieties of olives may be found. It is proposed to conduct spraying experiments for the control of this disease the current year, and as soon as suitable quarters for infection experiments are secured it is also proposed to test the comparative resistance of different varieties of olives to the disease and to study the action of germicides. A specially constructed hothouse, so planned that it can be easily disinfected, will be necessary for this work.

Diseases of the vine.—A serious disease of vines, which is now destroying thousands of acres of vineyards in the Santa Clara Valley, has been studied, and the field work has resulted in the selection of a resistant root. These facts have already been given to the vineyardists through the California press, and will probably enable the vine growers to reset their vineyards with ultimate success. There are many reasons for believing that this root will save the vineyards of southern California from the ravages of the California vine disease, and numerous vine growers are already preparing to test it on a scale commensurate with the heavy interests involved. Should these tests prove that the root is able to successfully support a tender top in the affected district one of the most obscure and destructive vine diseases known will be overcome in a simple and practical manner. Hundreds of acres of vines are also being grafted in the Sacramento Valley upon roots of vines found to be resistant in southern California to the disease in question. These extensive experiments are being directed and followed with interest. The coming season the testing of vine roots supposed to be resistant to the California vine disease will be greatly extended and the work on the vine trouble in the Santa Clara Valley will be continued.

A new raisin and table grape of fine quality, the result of crossing the Muscatel with the Almeria, is also being tested in the district in southern California where the California vine disease is prevalent. Thus far, it is growing finely, with no evidence of disease, but too little time has elapsed since planting to admit of any proper estimate of its hardiness. The testing of this grape will be continued in southern California.

Blight of sugar beets.—A thorough field study and careful laboratory investigations of a so-called beet blight, which caused heavy losses and considerable alarm in California during the season of 1900, have been carried on. The results obtained from the work have been against the opinion that the trouble is of a parasitic nature, but sup-

port the view that it is due to insufficient moisture in the subsoil at some time during the growing season. A brief report on the trouble was made, in which the main conclusions reached were given, together with recommendations which it is believed will lead to the overcoming of the blight and be of material advantage to the industry. The fact that the blight has disappeared with the past winter's normal rainfall is in harmony with the above conclusions. So far as may be necessary the study of the disease will be continued.

Miscellaneous.—Considerable data relative to black canker of the apple in Oregon and Washington have been collected, and if sufficient assistance can be provided and time permits, an extensive series of spraying tests to control the disease will be undertaken the coming season. In addition to the canker, a large number of minor diseases have been studied during the year, among them being a bacterial disease of loquats, which, as before mentioned, is perhaps pear blight. Besides the scientific work conducted at the Pacific coast laboratory, a large correspondence is carried on, and through this channel the influence of the work is materially extended.

WORK IN THE MISSISSIPPI VALLEY.

This work has so increased that it has been found desirable to establish at St. Louis what is known as the Mississippi Valley laboratory. Through the cooperation of the Shaw School of Botany and the Missouri Botanical Garden our work at this laboratory is greatly facilitated. The assistant in charge is vigorously prosecuting work on the special problems pertaining to the Mississippi Valley and also on diseases of forest trees and construction timber and the root rot of fruit trees. During the early part of the past year he made an extensive trip through California and the West studying the diseases of trees, collected and prepared for the Pan-American Exposition one of the finest exhibits of specimens of diseased wood ever made. He also prepared and published two bulletins and a Yearbook paper on diseases of trees, and inaugurated some extensive experiments in Missouri and Illinois for the purpose of working out a remedy for root rot and bitter rot. (See "Diseases of fruit" and "Root rot of fruit and other trees.")

WORK AT THE TROPICAL LABORATORY.

The large amount of information which we are called upon to supply relative to diseases and culture of tropical crops has made it necessary to establish the tropical laboratory in connection with the tropical garden maintained at Miami, as set forth in previous reports. An expert pathologist has been placed in charge of this laboratory, and the work is being pushed vigorously. Many new introductions have been set out in the garden during the year, and are being tested to determine their freedom from injurious diseases and for the purpose of propagating them for distribution to the State experiment stations and to others in the regions to which they are adapted. The hybrids being tested here will be discussed further under "Plant breeding." In addition to the work now being carried on, the laboratory will take up the study of diseases of truck crops for Northern markets, and will resume the work on citrous and other subtropical fruits, which was dropped on account of the destruction of such trees by the great freezes a few years ago.

PLANT LIFE HISTORY.

Studies of the life histories of the principal crop plants are being carried on to determine the exact environmental conditions necessary to each stage of growth, and although the researches in this line are still in their infancy, they have already yielded results of the highest importance to agriculture. The work consists in a thorough investigation of the exact requirements of climate and soil necessary to successful growth and profitable production, and is similar to that done on the date palm and set forth in the last Yearbook. It was not known why the date palm was unfruitful in Florida and in parts of California until our work demonstrated that a certain maximum amount of heat is necessary to the production and maturation of fruit. As a result of our studies in connection with this plant the areas where it will thrive have been mapped, and include large tracts that are now desert lands. It is known that much of the alkali desert land in Arizona and in that general region can be reclaimed at comparatively slight expense by establishing a rotation of alkali-resistant and heat-loving crops, with the date palm as a basis, as has been done in the oases of the Sahara Desert. Similar studies are in progress in connection with other crops and with the microscopic nitrogen gatherers of the soil, especially those that develop in connection with the clovers and other Leguminosæ. Other nitrogen-fixing microorganisms that give great promise of economic importance have been discovered. This work will receive special attention the current year.

Fixation of atmospheric nitrogen.—Special attention is being given to the whole subject of assimilation of atmospheric nitrogen by bacteria and other microorganisms, and in this connection a careful study is being made of the life history of the bacteria which inhabit the root tubercles of leguminous plants, and also of the plants themselves, with a view of finding a means of favoring the process and of better utilizing the nitrogenous matter thus formed in agricultural practices. Pure cultures have been made of many of the principal races of these bacteria, and we are endeavoring to find forms specially adapted to particular conditions of soil and climate. Such cultures, when obtained, are to be distributed to the experiment stations for use in artificial inoculation of soils on which new leguminous crops are grown. It is often the case that the most effective bacteria are wanting on soils on which such crops are being grown for the first time, and consequently no fixation of atmospheric nitrogen results unless the proper bacteria are introduced along with the new crop.

The life histories of the principal leguminous plants are being worked out, as before stated, in order to determine exactly the regions to which they are best adapted, so that the best system of crop rotations can be arranged and the best nitrogen-fixing plants for the various regions determined. It is our intention to give particular attention to the finding of new leguminous crops which will fix nitrogen abundantly for regions now lacking such plants or very poorly supplied, and we hope through this work to reduce the outlay necessary for the purchase of the very expensive nitrogenous manures and prevent deterioration of soils where no manure is applied. Comparative studies of the physiological and chemical action of the principal nitrogenous manures in comparison with the effects induced by preceding leguminous crops are also contemplated. Besides the bacteria above discussed, studies are being made of other soil bacteria which fix

atmospheric nitrogen, in the hope of finding a way of accelerating the beneficial action of species that do not require a symbiotic relation with the roots of higher plants. Nonleguminous plants will also be studied to find if possible some having root tubercles that will fix larger quantities of nitrogen or which are adapted to soil and climatic conditions unfavorable to leguminous plants. Other soil organisms which may aid or hinder the fixation of nitrogen are also receiving attention. It is hoped that by means of these studies the cost of nitrogen will be appreciably cheapened, and that a comprehensive knowledge will be gained in regard to sources of obtaining it, etc. A special fund will also be required for this important branch of our work.

PLANT NUTRITION.

For several years special attention has been given to plant nutrition in relation to the health of plants and their productiveness. It is not necessary to summarize the work already done along this line, but it may be said that during the past year we have completed preliminary investigations on the relation of lime and magnesia to plant growth and called attention to the fact that liming of soils is of much greater importance than has been heretofore realized. A report on this subject is now in press. A special investigation has also been carried on in regard to the relation of alkalis to plant growth, and observations of great practical importance have been made, especially in reference to the action of gypsum in diminishing the injurious action of magnesium and other salts which occur in alkali soils. It has been found that plants may support over one hundred and twenty-five times as much magnesium with a supply of gypsum as they can without it. A report of the work on the relation of alkali to plant growth has been prepared in connection with the Bureau of Soils, which is cooperating in this phase of the work, and is now going through the press. Another important phase of the work is the securing of alkali-resistant crops, and already we have obtained some valuable strains of alfalfa which will grow in soils having a higher percentage of alkali than any on which this crop has hitherto thrived. This will be discussed further under "Plant breeding," and will receive special attention during the current year.

PLANT BREEDING.

There is a constantly increasing interest in the subject of plant breeding, partially as a result of the work undertaken by the Department, and now many of the experiment stations and some private individuals and firms are engaging more actively in work of this nature. The results which have been obtained in our work in this line are in many cases far-reaching and of almost incalculable value. Owing to the fact that the obtaining of valuable variations requires considerable skill and is precarious and costly, private individuals are generally deterred from undertaking such work, hence it is very desirable that it should be pushed under the direction of the Government, particularly in cases where the work must be carried through a number of years to obtain definite results. The plants to which we have been giving special attention from the standpoint of breeding are those of the greatest agricultural value, but the limited amount of money at our disposal has greatly restricted the work under way and has prevented our taking up to any extent the improvement of

other crops, such as alkali-resistant plants, tobacco, rice, and certain vegetables.

Cotton.—The work in breeding cotton was started on a small scale in the fall of 1899, when a few crosses were made between improved strains of sea island and a black, smooth-seeded upland cotton, in the hope of producing a long-staple upland race. This work has been continued and greatly extended, and many new lines of investigation have been taken up. The production of races of upland cotton yielding a fiber from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches in length is of the highest importance. Cotton of this grade is worth from 15 to 20 cents per pound, and there is a constant demand for it. New mills for the manufacture of such a staple into fine yarn, underclothing, thread, etc., are continually being erected in New England and the South, but the fiber now used by them is largely imported. Several long-staple upland cottons which produce fiber of this grade already exist, but on account of their tufted seed they can not be readily ginned on a roller gin, which is practically necessary to avoid the tearing and breaking of the fiber. Sea island cotton grown in the interior of Georgia and Florida practically meets the demands, but this cotton is so unproductive and difficult to pick that it is far from satisfactory. Again, the regions suited to the production of sea island cotton, so far as is now known, are of limited extent. What is urgently required is a variety with fine, strong lint, from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long, and with big bolls, like the upland cotton, which open up well and are easy to pick. Such a variety to be successful must be more productive than sea island cotton on ordinary upland cotton soils. Several select hybrids have been produced in the course of the experiments and bid fair to meet the demand successfully if they can be bred into stable races. It will require several years of selection before these are sufficiently stable to put into the hands of growers, but it is believed that the most difficult step has already been taken. Several cotton experts who have examined these hybrids pronounce them excellent and most promising productions. They are the best of several thousand hand-bred hybrids of known parentage.

Considerable attention has been given, in cooperation with the Office of Seed and Plant Introduction, to establishing the growing of Egyptian cotton as an industry in this country, and preliminary trials in several locations have proved very satisfactory. A number of Egyptian varieties have been tested from the standpoint of breeding, but the results obtained were unsatisfactory, mainly because of unproductiveness. Last year experiments were started in the selection of different varieties of Egyptian cotton to increase productiveness, and some of the selections grown the present year are very promising. Patches of variety selections of Egyptian cotton from imported seed are being cultivated in South Carolina, Georgia, Florida, Mississippi, and Texas, and the results already obtained show almost conclusively that by a few years of careful selection the growing of Egyptian cotton in this country can be established on a paying basis.

Another important line of cotton breeding is the increasing and improving of the quality of the fiber of our standard races of upland cotton. During the present season experiments for the improvement of several of our best races were inaugurated, and it is confidently believed that the work can not fail to yield valuable results in a few years.

One of the most important phases of cotton breeding is the produc-

tion of disease-resistant strains. Experiments have shown that selected seed from plants which resist the wilt disease transmit their immunity in a wonderful degree, and it thus becomes feasible to control the disease by the easy and inexpensive method of breeding resistant varieties by selection. Our experiments have also shown that certain varieties, such as Jackson and some of the Egyptian cottons, are already largely immune to the wilt. Our work in this line was greatly extended the present season, but unfortunately was seriously checked by the cold, damp weather immediately following the planting. Under favorable conditions, we should have had seed of resistant strains to distribute for next year's planting.

Certain other diseases of cotton, such as the Texas root rot and anthracnose, may also probably be successfully controlled by breeding resistant strains, and experiments with this end in view have already been started.

The most important feature of the future work in the breeding of cotton is to fix into stable races some of the fine hybrids already secured. This will necessitate their being cultivated in isolated patches, away from other cotton fields, and selected until they become true to the type desired. Meanwhile the quantity of seed will be increased, so that by the time the race has been bred true to type we will have a sufficient amount of seed for distribution.

The Egyptian cotton selections which have proved productive will also be grown in isolated patches next year and further selections made. The breeding of strains of cotton resistant to wilt, root rot, etc., is of the greatest importance, and will be vigorously prosecuted on the lines already started.

Corn.—The breeding work on corn started several years ago has been continued and new lines of improvement have been inaugurated. This work is being carried on mainly at Washington and at Lincoln, Nebr., but patches of special productions are being grown in New York and Michigan. The severe drought in the West this year seriously injured our experiment at Lincoln, but it brought out some interesting facts as to drought resistance in the hybrids being tested.

Corn is used very extensively in the preparation of hominy for human food, but the sorts now most generally employed for that purpose are not particularly suitable. The flint races, which are the best for hominy, are not sufficiently productive for the farmer to grow them unless a better price could be obtained than for the ordinary dent corn, and this is not commonly the case. It is of the highest importance that sorts be secured which are richer in protein and nitrogen than the ordinary sorts, and it is believed this can be done by breeding, some of the hybrids produced in this way being very promising as special hominy varieties.

As in the case of cotton, it is believed that valuable results can be obtained by the rigid systematic selection of the best races of corn now grown with a view of securing increased yield and fixity of type. Experiments with this in view have been started in Ohio and will be continued next year. We have already secured from our experiments several hybrids which give promise of being early sorts. These are being grown the present season in New York and Michigan. The Peruvian or Cuzco, which is famous for producing the largest kernels of any variety grown, has been used extensively in our hybridization experiments with standard races of dent corn, but thus far the results have not been promising, the hybrids, though frequently vigorous,

being largely sterile, and in no case sufficiently productive to be valuable.

The coming year the promising hybrids that have been secured will be grown, tested, and selected in the regions for which they are thought to be best adapted. The work on the production of a prolific hominy variety, which promises to yield valuable results soon, will be vigorously pushed, and it is believed that one or two years' selection of some of the sorts in isolated patches will justify their distribution for more extensive trial by farmers. The production of races richer in nitrogen requires careful chemical work, and it is planned to make arrangements to have this feature of the work taken up the present year. As demonstrated by the Illinois and Kansas experiment stations, the gross character of the kernel indicates what may be expected, and attention has been given, as far as possible, to these characteristics in all our work up to the present time.

Wheat.—During the year breeding experiments with wheat have been carried on at Halstead, Kans., the heart of the wheat belt, and in Ellis County in that State, with a view of developing drought-resistant and hardy wheats, many of the best Russian wheats being used as a basis for the production of the latter feature. In addition to the crosses already made, about 300 varieties of Russian wheats and about 200 varieties of macaroni wheats were tested. A great deal of cooperative work in this line has been taken up with the experiment stations in different wheat-growing States, and extensive experiments are now under way at the Texas, Kansas, South Dakota, Minnesota, and Maryland stations. In the experiment at the Minnesota station special attention is being given to the breeding of wheats that will yield a higher percentage of nitrogen, and some very promising results in other directions also have already been obtained. During the coming season experiments on a large scale will be made for the purpose of producing varieties of greater nutritive value, disease and drought resistant, and hardier and better yielding than the present varieties.

Alkali-resistant plants.—Probably with no crops does breeding promise more valuable and far-reaching results than with those which might be grown on alkali soils. On such soils the great mass of plants finally die, but here and there some seem to withstand the injurious effects of alkali and mature successfully, and from this fact it is inferred that by careful selection from such plants for several years new strains resistant to alkali will be obtained. The Bureau of Soils has demonstrated that ordinary alfalfa will not grow successfully in a soil containing six-tenths of 1 per cent of alkali, but one of the agricultural explorers of the Bureau of Plant Industry discovered an Algerian alfalfa growing normally in a soil containing 4 per cent of alkali. Again, Algerian agriculturists have bred varieties of grapes which not only grow on alkali soils where ordinary varieties succumb, but do not take up the alkali in sufficient quantity to injure the wine made from them, and French vineyardists have bred varieties which will grow successfully on strong lime soils. In laboratory cultures of lupines with alkaline mixtures of various strengths, very great differences have been observed in the ability of different individuals to withstand injury from alkali. These facts justify the belief that by a systematic course of selection alkali-resistant strains of some of our agricultural crops can be secured, and during the present season an assistant has been giving especial attention to this problem and has started alkali-resistant selections with wheat, barley, and alfalfa.

Some difficulty is experienced in determining truly resistant plants, as the percentage of alkali in the soil may differ materially within a distance of a few feet, and a plant apparently resistant may owe its success to a lower percentage of alkali in the soil under it and not to any inherent resistance. Before a plant is finally selected for breeding purposes, therefore, it is necessary to make a careful test of the soil immediately beneath it.

Crossbreeding such resistant plants with resistant varieties imported from other countries also furnishes an important field for experiment. The results already obtained are very encouraging, and if the necessary funds are provided the work will be extended and vigorously prosecuted. The work will include the selection of seed from resistant plants, the growing and testing of such seed, the crossbreeding of resistant strains, the selection and adaptation of imported resistant strains, etc. The work is of the greatest importance and should receive commensurate attention.

The orange.—The work of breeding a hardy orange by crossing the hardy Japanese trifoliolate with the different varieties of the ordinary sweet orange has not yet reached a final conclusion. It was thought that some of the trees would fruit this year, but they have not done so, owing probably to the fact that the bud wood was taken from the hybrid seedlings while very young. Budded trees of each of the hybrids have been distributed to various experiment stations in the Southern States to be grown and tested and also to furnish bud wood for distribution of any sorts that may prove valuable. Several of the hybrids having trifoliolate leaves like the trifoliolate orange parent, but much larger, are of evergreen habit, and have shown themselves quite hardy. Should these produce good fruit, they will be sufficiently hardy to endure the cold of ordinary winters in the Gulf States. As stated in the previous report, some of these hybrids will make valuable hedge plants and will be of great value for this purpose alone. The hybrids which fruit will be carefully tested and studied and those which prove promising will be propagated as rapidly as possible to secure buds for distribution should the results of a second year's fruiting show the fruit to hold up. The value of a variety can be determined only after several years' growth under a wide range of conditions, and only the growing of a variety on a commercial scale would furnish such a test. Of course, it is manifestly impossible for the Department to make such a test; but if after two years' fruiting a sort seems valuable it will be grown and distributed.

Grape fruit and tangerines.—The hybrids of different varieties of grape fruit and tangerines, made particularly to obtain new fruits of better or distinct quality, will fruit this fall for the first time, and it is confidently expected that some of them will show improvements of value.

Grapes.—All breeding work done with grapes was carried on by the assistant in charge of the Pacific coast laboratory, and is discussed under the heading of "Work on the Pacific coast."

The pear, apple, and peach.—During the year quite a large series of hand pollinations were made with the Kieffer pear in the vicinity of Washington, D. C., in order to get more exact knowledge about this important commercial variety and also to secure new hybrids between the Kieffer and choice dessert pears, such as Seckel, Anjou, Mannings, etc. A fine lot of cross-pollinated Kieffers has resulted from the sea-

son's work, and these should produce at least two or three thousand seedlings, from which we hope to obtain pears having the quality of the Bartlett and Seckel and the disease resistance of the Kieffer. Several hundred fine seedling hybrids are now growing on the Department grounds as a result of our work in this line. We hope to continue the work each year until an entirely new race of pears, which will cover all seasons of the year, is obtained. Similar work will also be carried on with the apple. As stated under "Diseases of fruit," some peaches seem immune from rot in orchards where the disease is very destructive. It is hoped to undertake experiments in breeding varieties which will resist this disease.

Pineapples.—A number of pineapple hybrids produced by crossing and now growing in Florida have fruited this year for the first time. The proportion of valuable hybrids in this collection is remarkable, and the fruit is excellent. The extent of variation shown is remarkable, no two being alike. The production of smooth-leaved varieties was one of the main objects of the crossing, and some of the best of the hybrids have smooth leaves. The valuable hybrids will be propagated as rapidly as possible and tested more thoroughly, but it will require several years to secure sufficient stock to enable us to distribute plants to growers. A number of the hybrids have not yet fruited and it is probable that other valuable sorts may be secured from these. As the pineapple is one of the most important fruits in our new possessions and its commercial importance to Florida is second only to the orange, the production of improved varieties is of considerable moment, and work with it will be extended and vigorously prosecuted.

Miscellaneous fruits.—Some work has been started on other fruit crops which are not of so great importance commercially. In the case of the guava, which is one of the most important household fruits of the Tropics and subtropics, many selections have been made of plants producing very few seeds. A number of seedlings of these are being grown, with the hope of securing varieties with fewer seeds than any now known. The guava is capable of great development and should be carefully bred. Work is also being carried on with the strawberry in the hope of producing late varieties, and this will be continued the coming season.

Principles of breeding.—In connection with the practical work in progress, a careful scientific study is being made of the principles underlying breeding. While many fundamental principles are well understood, some of them are still quite obscure, as, for instance, the effect of environment on plants, which is so important and the knowledge of which is so meager that it can not be intelligently utilized. Experiments for the purpose of obtaining light on this factor have been arranged with several of the experiment stations. The prepotency of pollen and preponderance of one species over another in hybridization are not understood with any degree of accuracy and are being investigated. The immediate effect of pollen, until recently a botanical enigma, has finally been cleared up and is now thoroughly understood, the work which we have carried on having had much to do with its final solution. The problems of heredity, which are among the most obscure and important of biological questions with which the scientist has to deal, bear closely on the work of the practical breeder, and studies looking to a clearer understanding of the laws governing these will be prosecuted as rapidly as possible.

HERBARIUM.

In the examination of diseased plants sent in from all parts of the world it is necessary to identify the parasitic fungi associated with the various diseases, and in this work the herbarium is indispensable. Our collections of economic fungi have been largely increased during the past year, as have also our facilities in the way of card catalogues, etc. The amount of work involved in connection with the herbarium has made it necessary to appoint another assistant. The demand for the identification of edible and poisonous fungi is so great that this work occupies almost the entire time of one expert, at least during the season for such fungi. Sets of duplicate specimens have been carefully named and have been prepared for distribution to the experiment stations, but owing to lack of assistance we have been unable so far to send them out. It is hoped that this work can be attended to during the current fiscal year, as we have many requests for sets on file.

ADMINISTRATIVE WORK.

The correspondence of the office is rather heavy, amounting during the year past to probably not less than 10,000 letters, exclusive of circulars. We believe this to be one of the best channels through which to impart the information and assistance that should be furnished to those for whose interests the work is being carried on, and careful attention is given to all communications. The number of diseased plants sent to us for examination and report is very large, and requires much of the time of two expert pathologists.

During the year we have issued 7 bulletins, 1 report, 1 circular, and 3 Yearbook papers. The subjects discussed in these publications are, respectively, *zenia*, or the immediate effect of pollen in maize; spot disease of the violet; the basis for the improvement of American wheats; some diseases of New England conifers; Wakker's hyacinth germ; the wilt disease of cotton and its control; the cultural characters of *Pseudomonas hyacinthii*, *P. campestris*, *P. phaseoli*, and *P. stewartii*; catalase, a new enzym of general occurrence; a new wheat for the semiarid West; fungous diseases of forest trees; commercial pear culture; and successful wheat growing in semiarid districts. In addition to these, we have prepared and have now in press 3 bulletins, 1 report, and 2 Farmers' Bulletins, which treat, respectively, of plant breeding; the relation of lime and magnesia to plant growth; spermatogenesis and fecundation of *Zamia*; some mutual relations between alkali soils and vegetation; emmer, a grain for the semiarid regions; and pineapple growing.

As stated under different headings, we have on hand a large collection of data on different subjects, and during the year we hope to issue publications on macaroni wheat; bitter rot of the apple; diseases of the peach; cotton; the mosaic disease of tobacco; diseases of the sugar beet; black canker of the apple; corn breeding; corn selection, etc.

As heretofore, a number of lectures have been delivered by members of the force before scientific societies, horticultural associations, farmers' clubs, etc. Although this requires considerable of the time of the experts, it brings our men into close touch with the practical men outside and affords the best opportunities for bringing together the practical and the scientific. Our workers have been much benefited by such experience, and the appreciation of such lectures by organizations has been repeatedly expressed.

THE PAN-AMERICAN EXPOSITION.

The remarkable success of our exhibit at the Paris Exposition made it seem desirable to reproduce certain features at the Pan-American Exposition at Buffalo, among these being exhibits showing the cereals for milling and transportation, new varieties of cereals produced in the United States, etc. A new feature of the exhibit is a large collection of wood, showing the parasites causing the decay of construction timber and forest and shade trees. The wood was carefully prepared, and the parasites causing the decay are in most cases clearly shown. This exhibit is designed to give those interested a clear idea of what investigations the Department is carrying on in this line. Another portion of the exhibit illustrates the methods of treating the most injurious plant diseases. This has proved to be a very popular feature. The plant-breeding work of the Department is also represented by photographs and specimens, the subject being presented in such a way as to convey a good general idea of the work being done.

REPORT OF THE BOTANIST, FREDERICK V. COVILLE, ON WORK OF THE YEAR.

SEED-TESTING WORK.

During the year ended June 30, 1901, more samples of clover and grass seeds have been sent in by seedsmen and farmers for testing than ever before. In a number of cases seedsmen have sent samples for examination and have depended upon our report to guide them in the purchase of large quantities of seed. We intend to encourage this practice and to be in a position to furnish prompt and accurate information in such cases. We also hope to inaugurate a system by which seedsmen may guarantee a standard grade of field seeds. With this in view, we are now training additional help to do the careful mechanical work required.

DEPARTMENTAL TESTS.

Some 400 samples of grass seed were tested for the Office of Grass and Forage Plant Investigations, and all the important seeds distributed by the Office of Seed and Plant Introduction in any quantity have been tested for purity and germination. The testing of seed for Congressional distribution has necessitated a great deal of work, owing to the large number of sample lots sent in by the contractor. Our facilities for testing the seeds to be supplied for the large contract of next winter are satisfactory and we shall be able to make prompt reports.

STUDIES OF KENTUCKY BLUE-GRASS SEED.

Extensive studies have been conducted upon the curing and methods of germination of Kentucky blue-grass seed. It has been shown that the poor quality of much of the Kentucky blue-grass seed on the market is due to improper harvesting and curing and that this can easily be avoided in the future by changing some of the methods at present in vogue.

STUDIES ON THE IDENTIFICATION OF SEEDS.

These studies have been carried on for the following genera: *Brassica*, *Agrostis*, *Atriplex*, *Lolium*, and *Festuca*. The work on *Brassica*

and *Atriplex* has been completed, but that on the grasses can not be completed this year. This work will be continued in connection with the seed collection, and it is planned to prepare careful descriptions and illustrations of the seeds of the principal economic plants and of weeds.

IMPORTANCE OF THE ORIGIN OF SEED.

Work on the relative value of clover seed grown in the different States and in foreign countries was carried on last year in cooperation with nine experiment stations. In our trial grounds the results were the same as those observed during the previous year's investigations. The plants grown from European seed were utterly unable to withstand our hot sun, and while they made some growth during the cooler spring weather, they ceased growing, and even to a considerable extent dried up, as soon as the intense heat of summer set in. The preliminary reports so far received from the cooperating stations indicate that the same was true in other parts of the country. This work will be carried on for one year more, when it will be considered completed.

NEW WORK IN THE PURE-SEED INVESTIGATIONS.

During the current year it is planned to complete some of the investigations undertaken last year and to carry on the regular work of seed testing, besides conducting investigations on the growing, harvesting, and curing of orchard-grass seed and of redtop seed. Some studies will also be undertaken of the temperatures in the upper 3 inches of the soil during the time when seeds are actually germinating. This work will be made to apply in the first instance to clover seed, since the importance to the Eastern farmer of getting a stand of clover is too great to permit of the subject being longer neglected. The work will be carried on under the direction of competent assistants in various parts of the country, as may be found necessary. Another line of work will be on the treating and preserving of seeds. The difficulty of preserving the germinative power of certain common seeds, as Kafir corn, soy beans, etc., makes it advisable to investigate the methods of growing and storing these seeds, since there is no doubt that with more careful treatment the germinating quality can be considerably improved, insuring a better stand and less danger of failure when the seeds are planted. The treatment of seeds to guard against disease, as in the case of sugar-beet seed and of oats and other cereals, will also be investigated, more especially from the standpoint of the effect of such treatment on the seed. European investigations have shown that it is possible to detect the presence of the disease germ in sugar-beet seed before it is planted. The great increase of the sugar-beet industry in America makes it imperative that we should be in a position to test this seed not only for purity and germination, but also for the presence of disease germs, in cooperation with the Pathologist and Physiologist of the Bureau.

The exorbitant price asked for the seed of hairy vetch, and the fact that the Department explorers have called attention to a number of promising leguminous plants, the seeds of which are not on the market, make it desirable that systematic work be done to determine whether seeds of these plants can be profitably and cheaply raised in some part of the United States. That this must be done before these plants can find popular acceptance is self-evident, since few farmers

would consider it profitable to pay more than \$2 or \$3 per acre for seed. The cost now of seeding an acre to hairy vetch is between \$8 and \$10. Plans have therefore been made for experiments on growing seed of hairy vetch and also of rape seed, the use of which is rapidly increasing in this country.

CEREAL INVESTIGATIONS.

A study of the methods and characters used in the determination of different varieties of wheat has been made, and also a study of the methods of chemical analysis applicable to the identification of varieties and the determination of grades. The Algerian durum wheats, including several varieties used in the manufacture of macaroni, have been investigated in Marseilles and in Algeria with a view to their adaptability for introduction into this country. An account of these varieties has been prepared for publication.

It is proposed during the coming year to conduct investigations along three lines, as follows: (1) Wheat varieties; (2) wheat grades; (3) the deterioration of corn in transit.

The work on wheat varieties will include the devising of simple and satisfactory methods for the accurate description of varieties of wheat now being grown or likely to be grown in this country, the systematic classification of the varieties, and the correction of the nomenclature, so as to facilitate experimental and commercial work.

The first work in connection with wheat grades will be the collection of data concerning methods of inspection and grading now in use in the United States. This work is already well under way, and is leading to the discovery of new and apparently valuable methods of determining intrinsic qualities in wheat, upon which a rational system of grading may be based. The system of grading now in vogue seems to do very little but facilitate trade. A statement of grade is not a statement of the real value of a grain, but rather a statement of its condition, so that "legitimate" trading in grain is done very largely on a sample basis. There remains to be worked out a system of grading such that the market will discriminate in favor of what are really the more valuable grades, and that this discrimination may be in effect all the way from producer to consumer. This will lead to the exclusive culture of the more valuable sorts of grain and tend to greatly improve the average quality of the product of the country.

Investigations upon the deterioration of corn are well under way and should be nearly completed by the close of the present fiscal year. Complaints made by Liverpool merchants concerning the condition of corn arriving at that port have been proved to be well founded, as considerable quantities were arriving in bad condition. This was due to the fact that the corn contained too much dirt and too much moisture when put on board ship. Further investigations will be made to determine the actual facts concerning the amount of moisture and of dirt which makes the shipment of corn under those conditions impracticable, and also in regard to methods of improving the condition of corn not fit for shipment.

FIBER INVESTIGATIONS.

Reports received from numerous stations where Egyptian cotton was grown from seed distributed in the spring of 1900 by the Office of Seed and Plant Introduction indicate that this variety may suc-

ceed in some localities along the Gulf coast, and especially in southern Georgia and northern Florida, where sea island cotton is grown away from the coast. Further experiments with this cotton were begun in the spring of 1900 in those regions where favorable results were obtained, and also in Porto Rico and Hawaii.

Experiments in the cultivation of several European varieties of hemp, as compared with improved Kentucky hemp, were instituted in the testing garden of this Department and at six places in the Carolinas. In each instance the Kentucky hemp was superior to the foreign varieties. Some of the hemp grown in the testing garden was water-retted, and although satisfactory facilities for breaking and cleaning the fiber could not be secured, some samples of the fiber itself, examined by an expert linen manufacturer, were pronounced equal to the best grades of imported Italian hemp. In the spring of 1901 seed of several varieties of Japanese hemp were imported through the Office of Seed and Plant Introduction, and they are now being grown in the testing garden and at six other stations. Some of them give promise of much value.

It is proposed during the coming year to continue culture tests with foreign and improved native varieties of hemp and also conduct experiments in the production of flax, and begin work on a classification of American varieties of cotton.

TROPICAL AGRICULTURE.

Even before the acquisition of tropical territory by the United States a large number of inquiries regarding tropical crops and products were received annually from merchants, investors, and colonists. In the last three years popular interest in the Tropics has become general, and the demand for information on tropical botany and agriculture is now very great, and often pressing, especially from those engaged in the production of public and private improvements in the new possessions of the United States. The volume of American investments in tropical countries is also rapidly increasing, and to secure the largest possible share of such capital and enterprise for Porto Rico, Hawaii, and the Philippines, detailed and reliable information is necessary regarding the useful plants and agricultural methods suitable for these islands.

Previous to the appropriation for the year 1901-1902 little in the way of investigations in tropical agriculture could be undertaken, but a beginning was made with a study of the useful plants and agricultural conditions of Porto Rico. Special attention has been given to coffee, which is at once the most important agricultural industry of Porto Rico, and, with the exception of sugar, the largest of the agricultural imports of the United States. A bulletin on shade in coffee culture has been published, in which it is shown that the coffee plantations of Porto Rico are rendered relatively unproductive by use of too much shade. The good effects commonly ascribed to shade are explained as the indirect results of the protection of the soil from drought and of the fertility imparted by the nitrogen-collecting root tubercles of leguminous trees generally planted for shading coffee.

Plans for these investigations contemplate the continuation of the study of coffee and of other crops now grown in the islands mentioned, with a view to the improvement of varieties, methods, and markets, and the investigation of other tropical plants and agricultural methods likely to be of use in the new colonies. Further publications

on coffee and upon the tropical fruits, root crops, and other useful plants of Porto Rico are in preparation.

Existing industries of importance demand earliest attention, but the possibilities of rubber and other cultures which supply the tropical products now imported from foreign countries receive careful consideration. This work is intended to supplement the detailed and localized investigations of the experiment stations which are being established in the new colonies, to connect them with the Department, and to assist in supplying improved plants and methods which may exist in other parts of the Tropics.

INVESTIGATIONS OF POISONOUS PLANTS.

Work on poisonous plants has been carried on in the office, the field, and the laboratory.

One hundred and five cases of plant poisoning, mostly human, have been investigated by correspondence, and more than 800 letters, asking for information about poisonous plants or for the identification of plants supposed to be poisonous, have been answered. The pharmacological collection and the index of information about poisonous plants and those having useful chemical properties have been greatly enlarged.

Field and laboratory investigations on the stock-poisoning plants of Montana, begun in the spring of 1900, were continued during the summer and have been extended to Oregon and Washington. These investigations have resulted not only in the determination of the species causing the greatest loss among stock and the seasons during which these species are most dangerous, but also in the demonstration of an effective remedy, permanganate of potash, by the use of which a large proportion of the loss may be averted. The results of these investigations have been published in Bulletin No. 26 of the Division of Botany.

It is proposed during the coming year to extend the investigations in the field and laboratory and to enlarge the work in the office. There is an urgent demand from many parts of the West for special investigations on the loco weeds, which cause heavy losses of stock nearly every year. Work promising good results has been begun on the loco weeds in Montana. As there are several species of this group of plants having different geographical ranges, this work should be extended to Texas, New Mexico, California, and other parts of the West where stock raising is an important industry. It is hoped that more room and better facilities may be secured for office and laboratory work along these lines.

TESTING GARDEN.

Fifteen acres of land have been added to the testing garden, making a total area of 40.6 acres now cleared and fenced. Variety tests have been made with samples of all seeds for the Congressional distribution suitable for growth in this latitude. Tests have also been made with a large number of the different kinds of seeds imported by the Office of Seed and Plant Introduction, and especially with all plants of the melon family and all soil-renovating leguminous plants. A special study has been made of the varieties of lettuce, seeds of more than 400 named varieties being grown for comparison. A careful record of all these varietal tests has been made. Preliminary experimental work

in soil heating for forcing lettuce and other vegetables gives promise of important results along these lines.

The work proposed for the coming year will include further tests in growing vegetables in artificially heated soil, experiments in celery culture, and the usual variety tests of seeds for Congressional distribution.

MISCELLANEOUS WORK.

During the year three circulars containing popular information, two illustrated bulletins, partly technical in character, and two numbers of Contributions from the United States National Herbarium have been issued. Arrangements have also been made for the publication of other bulletins and numbers of the Contributions, some of which were nearly completed at the close of the fiscal year. An investigation was made, in cooperation with the Division of Forestry, in regard to the botanical resources in northern Arizona and for the purpose of securing data to be used in determining the management of certain forest reserves in that region. The seed laboratory prepared the botanical exhibit at the Pan-American Exposition. The central thought in the exhibit was to show the actual cost of the pure and good seed in the different samples of commercial seed. The apparatus and equipment for a seed-testing laboratory were also shown, as well as a collection of weed seeds and live weeds. The exhibit attracted considerable attention, and it is hoped the popular interest in good seeds will be advanced by it.

The correspondence of the office has necessitated the writing of nearly 4,000 letters. The miscellaneous correspondence now takes a large proportion of the time of the assistant botanist. But while this increased demand for information indicates to some extent an increased interest in botanical subjects and a growing interest in the work of this Department, it takes time that should be given to the work of conducting investigations. It is expected that more satisfactory arrangements may be made for this work during the coming year.

REPORT OF THE AGROSTOLOGIST, F. LAMSON-SCRIBNER, ON WORK OF THE YEAR.

The investigations of grasses and forage plants have been carried on through this office in accordance with plans outlined in the last annual report, particular attention being given to the field work, the collection of seeds of promising grasses and forage plants, the study of the distribution of these plants and their value, and the planning and carrying on of cooperative experiments along various lines with a number of the State experiment stations.

FIELD WORK.

The field work and collection of seeds was placed in the immediate charge of Mr. C. L. Shear, an assistant in the office, who, with a number of agents specially appointed, carried on the work in Colorado, Wyoming, Montana, Washington, Oregon, and Arizona. Efforts were made to secure as large quantities as possible of seeds of grasses and forage plants of known value in arid and alkaline soils. Two agents worked in the northwestern part of Montana, where they secured a large quantity of seeds and roots, as well as specimens of many valuable native species; they also obtained important information regarding the forage conditions and needs of that region. It was found that the stockmen and ranchers were taking an active and increasing interest in the problems connected with grasses and forage

plants, and that there was much appreciation shown for the work which is being carried on by the Department in this direction. Large quantities of seed of native saltbushes were collected in Wyoming. Past experience with these saltbushes seems to indicate that some of them at least may be successfully and profitably introduced into cultivation. Stockmen have already recognized the value of the native saltbushes, and some of them have undertaken experiments in their cultivation. The difficulties encountered in collecting seeds of native forage plants are many. A single species rarely occupies sufficient area unmixed to admit of its being harvested by any of the modern methods of harvesting hay or grain, hence nearly all of the work has to be performed by hand, thus making it rather slow and tedious.

As a result of the field work, seed of about 150 varieties of grasses and forage plants were secured in quantities varying from 100 to 500 pounds. The total amount collected in the field was about 4 tons. Large quantities of roots were secured and transplanted in various localities. Several hundred specimens of interesting species were also secured for the herbarium or for exhibition purposes. Besides the seeds collected, large amounts of commercial seeds have been purchased for use in experiments in different sections of the country in cooperation with experiment stations. About 9 tons of seeds of grasses and forage plants have been purchased from such sources and distributed. About 10½ tons of seed have been distributed to the various State experiment stations. The distribution of these seeds required a large amount of time and labor, as most of them were distributed in small packages, which required separate weighing, packing, labeling, and recording. Card indexes have been kept of all seeds received and distributed, so that by reference to these the amount of seed of any particular variety which has been secured and the parties to whom it has been distributed, with the amounts sent in each case, can be easily ascertained.

The result of the season's work in seed collecting is fully presented in Mr. Shear's report, which was published as Circular No. 9 from the office of the Secretary. This report contains a complete list of the varieties collected, with a brief description of the more important ones. The results of the seed and field work carried on by the office during the past five years is presented by Mr. Shear in Bulletin No. 25, now in press.

COOPERATIVE WORK.

In years past much cooperative work has been carried on between this office and the State experiment stations in the cultivation of new and untried grasses, as well as in the preparation of bulletins relating to the grasses or forage resources of different parts of the country, but not until the present year has any real effort been made to organize the work upon a systematic scheme or plan. Articles of agreement have been drawn up by this office and submitted to the directors of the experiment stations for approval. The following are examples of these articles of cooperation:

Articles of cooperation in investigations on improvement of the Northwestern ranges between the ——— Agricultural Experiment Station and the Division of Agrostology, United States Department of Agriculture.

The object of these investigations shall be to find the best and most practical way of improving the forage conditions in the dry sections of the Northwest, and specially of renewing the worn-out ranges and devising methods of managing

them whereby the highest degree of productivity may be maintained. The following plan of cooperation is agreed upon:

1. The _____ experiment station to procure a suitable tract of range land; to undertake immediate supervision of the work through a member of its official staff, and to furnish all implements, fencing, etc., required by the investigations, the same to be the sole property of the station when this cooperative arrangement is dissolved.

2. The U. S. Department of Agriculture, through the Division of Agrostology, to assist in selecting the land and in planning and conducting these investigations; to furnish seed of native and introduced grasses and forage plants for experiments on said tract, and pay other expenses connected with the investigations not to exceed _____ in any one fiscal year, it being understood that under the appropriation act the Department can not assume responsibility for the continuance of its contribution beyond June 30, 1901.

3. The investigations conducted under this cooperative agreement shall be planned conjointly by the representatives of the _____ experiment station and the Division of Agrostology, officially charged with the work, subject to the approval of the proper authorities in each case.

4. Both parties to this agreement shall be free at any time to use the results obtained in these investigations in their official correspondence and publications, giving proper credit to the fact that such results have been secured by cooperative work.

Director _____ Experiment Station.

Chief Division of Agrostology.

Approved:

Secretary of Agriculture.

Articles of cooperation in grass and forage plant investigations between the _____ Agricultural Experiment Station and the Division of Agrostology, United States Department of Agriculture.

The object of these investigations shall be to find the best crops for supplying forage to supplement the natural ranges and for the improvement of cultivated lands. The following plan of cooperation is agreed upon:

1. The _____ experiment station to provide land at the home station, or at outlying representative points in that territory, upon which to make said experiments, and to undertake the immediate care and supervision of the work.

2. The U. S. Department of Agriculture, through the Division of Agrostology, to furnish all seeds necessary in making these experiments, and to otherwise assist in planning and conducting said investigations.

3. The investigations conducted under this cooperative agreement shall be planned conjointly by the representatives of the _____ experiment station and the Division of Agrostology officially charged with the work, subject to the approval of the proper authorities in each case.

4. Both parties to this agreement shall be free at any time to use the results obtained in these investigations, giving proper credit to the fact that such results have been secured by cooperative work.

Director _____ Experiment Station.

Chief Division of Agrostology.

Approved:

Secretary of Agriculture.

The lines of work which have been taken up in cooperation with the stations, in accordance with these signed agreements, include a great variety of problems. Some of these problems, together with the stations with which they have been severally taken up, are: To find the best and most practical method for the formation and management of meadows and pastures in the Middle Southern States, in cooperation

with the Tennessee experiment station; the testing of drought-resistant grasses and forage plants likely to be of value in the range region, in cooperation with the South Dakota experiment station; the best crops for supplying forage to supplement the natural ranges and for the improvement of cultivated lands, in cooperation with the New Mexico experiment station; the best and most practical method for the formation and management of meadows and pastures in the Middle Western States, in cooperation with the Missouri experiment station; the best grasses for fixing the drifting sands along the Great Lakes and to determine the possibility of converting these into lands productive of forage and other crops, in cooperation with the Michigan experiment station; to find the best grasses for fixing the drifting sands on the Pacific coast, and to determine the possibility of rendering such lands productive of forage and other crops, and the selection and improvement of varieties of grasses, in cooperation with the Oregon experiment station; the improvement and renovation of worn-out hay and pasture lands, in cooperation with the New Hampshire experiment station; the use of cover crops for orchards, in cooperation with the Delaware experiment station; pasture and range improvement, in cooperation with the Kansas experiment station; to find the best crops for use in securing a continuous soiling series for dairy and farm stock in the Eastern United States, in cooperation with the Maryland experiment station; to find the best and most practical way of improving the forage conditions in the dry sections of the Northwest, and especially of renewing the worn-out ranges and devising methods of managing them whereby the highest degree of productivity may be maintained, in cooperation with the Washington experiment station; grasses and forage plants for alkali soils, in cooperation with the Wyoming experiment station; to find the best and most practical way for the formation of meadows and pastures and to discover methods of managing them whereby the highest degree of productivity and usefulness may be maintained, in cooperation with the Texas experiment station; to find the best and most practical way of improving the forage conditions in the arid Southwest, and especially of renewing the worn-out ranges and in devising methods of managing them whereby the highest degree of productivity may be maintained, in cooperation with the Arizona experiment station.

Articles of cooperation have now been signed with thirteen of the State experiment stations. A report of the organization of this plan of cooperation was published as Circular No. 8 from the office of the Secretary. This report was by Mr. Thomas A. Williams, now deceased, and was based on personal visits to many of the State stations, where the subject of the experiments and manner of cooperation were fully discussed with the station officials. This work has been continued by Prof. A. S. Hitchcock, of Kansas, who has been placed in charge of cooperative experiments. Reports of progress have already been received from some of the stations, the one from Arizona, prepared by Dr. David Griffiths, expert in field management, deserving special mention.

ARIZONA.

The cooperative work with the Arizona experiment station is in the line of range improvement, the land selected for the purpose occupying what is described in the Government surveys as sections 27, 34, 35, and 37, T. 14 S., R. 14 E., Gila and Salt River meridian, and by order of the President this land was withdrawn from entry and set aside for

use of the Department in experiments with grasses and forage plants. This tract of land is near Tucson, although some 400 feet higher, and is about 2,600 feet above the sea level. The land was fenced, and when selected in September, 1900, the ground was bare, except for cacti and a few small shrubs of little or no value for forage. From January until March the ground was fairly well covered with short-lived annuals, the most conspicuous being California poppy and tufted plantain, which latter is of some value for grazing. It is evident that the present unproductive condition of the ranges in this part of Arizona is due in the greatest measure to overstocking and injudicious management. The perennial grasses have been completely destroyed on a large portion of the range and can not be restored except by fencing and reseedling. Some 52 acres of the fenced portion of the reservation are now under cultivation, and this area has been divided into 60 plots, upon which about 40 species of forage plants have been sown.

One correspondent living in Oracle, Ariz., in replying to the inquiries relative to forage conditions of the Territory, states:

The present unproductive conditions are due entirely to overstocking. The laws of nature have not been changed. Under similar conditions vegetation would flourish on our range to-day as it did fifteen years ago. We are still receiving our average amount of rainfall and sunshine necessary to plant growth. Droughts are not more frequent now than in the past, but mother earth has been stripped of all grass covering. The very roots have been trampled by the hungry herds constantly wandering to and fro in search of food. The bare surface of the ground affords no resistance to the rain that falls upon it, and the precious water rushes away in destructive volumes, bearing with it all the lighter and richer particles of the soil. Vegetation does not thrive as it once did, not because of drought, but because the seed is gone, the roots are gone, the soil is gone. This is all the direct result of overstocking and can not be prevented on our open range, where the land is not subject to private control. I respectfully urge upon you the importance of impressing the Government officials with the fact that no general improvement of range country can be expected until the land is placed under individual control by lease or otherwise. The greater part of our range country is at present desert and will steadily become less and less productive while the present range management, or rather lack of it, prevails.

In March and April of the present season Mr. Shear visited the experiment stations of Kansas, Texas, New Mexico, and Arizona, with the view of inspecting the grass and forage-plant work being carried on in those States, and especially to inaugurate the experiments to be carried on in cooperation with the Kansas station on the farm of Mr. H. B. Waldron, of Anthony, Kans. The work here planned is the trial of various methods of improving the range and pasture lands and the introduction of such grasses and forage plants as may give promise of success in this general region. Seeds of grasses and forage plants collected or purchased by the office have been supplied in large quantities to a number of experiment stations with which no articles of cooperation have been signed, being sent either directly to the stations or to individuals upon the request and recommendation of the station officials.

ABILENE, TEX.

The experiments in range improvements which this Department has been carrying on during the past three years at Abilene, Tex., under the immediate supervision of Mr. H. L. Bentley, have been concluded, and Mr. Bentley's final report of the operations for the entire period and results obtained is now in the hands of the Agrostologist. This report is a most interesting one, and the work at Abilene has

clearly demonstrated the possibility of greatly improving the cattle ranges with comparatively little cost. Through the plan pursued at Abilene the stock-carrying capacity of the range land selected for the experiments was doubled, and Mr. Bentley asserts that it is not only possible to restore the worn-out and grass-denuded ranges to their former productiveness, but that while this is being done cattle may be held on the pastures each year, the proportion increasing year after year as the capacity of the pastures to sustain them shall be increased. The work accomplished at Abilene has attracted much attention, as the question of range improvement is a most important one, and no work undertaken by the office is more promising of useful results.

GRASS GARDENS.

During the past year grass gardens have been maintained on the Department grounds on the Potomac Flats, District of Columbia, and one was established as a part of the exhibit of this Department on the grounds of the Pan-American Exposition at Buffalo, N. Y. The garden on the Department grounds has been remodeled, to bring it more in the line of an educational exhibit than of an actual series of experiments with grasses and forage plants. The center of the garden is occupied by a series of beds or plots of native and introduced pasture grasses. These are kept closely mown, to imitate as nearly as possible the actual grazing by stock, with the intention of determining in part which will best stand such treatment. The rest of the garden is devoted to displaying as many varieties as possible of native and introduced grasses, clovers, and other forage plants. A series of plots containing eight different species of clovers has been planted, in order that the habit of each species may be studied by comparison with that of the others. Several plots of alfalfa sown with seed derived from different parts of the world illustrate the relative hardiness and productiveness of these different sorts. An artificial sand dune has been placed in the garden, and upon it have been planted a number of sand-binding grasses. A similar but more extensive dune was placed in the garden at the Pan-American Exposition, and there the sand binders found upon the Atlantic and Pacific coasts and in the sandy regions of the interior have been grown successfully, both from seed and from transplanted roots. About 250 species are included in the garden on the Department grounds, and nearly half that number are growing in the garden at Buffalo.

The work of testing the various native and introduced grasses and forage plants on the Potomac Flats was begun in the spring of 1900 and is still in progress. During the season of 1900 about 400 different plants were grown on the flats and full notes taken concerning their growth, relative hardiness, time of maturity, seed production, etc. The report of the work conducted on the flats was prepared by Mr. C. R. Ball, to whom has been assigned charge of the grass garden and all experiments with grasses and forage plants in the District of Columbia, and was submitted at the close of the season and published as Circular No. 28 of this office. The work of this season was seriously delayed in the spring on account of protracted wet weather, and it has been interfered with by the dredging operations which are now being carried on. This work on the flats will be transferred to the experiment farm at Arlington another season. At the present time the grass garden on the grounds of the Pan-American Exposition is in excellent condition and has attracted a great deal of attention from

visitors. Much of the success of this garden is due to the intelligent efforts on the part of Mr. Thomas Hanley, an expert in the office, who has had immediate care of it.

WINTER PASTURAGE.

In February of the present year Mr. Ball, assistant agrostologist, visited the States of Alabama, Mississippi, and Louisiana for the purpose of investigating the problem of winter pasturage. There is almost universal demand for such crops throughout this region, and the experiment stations of these States are carrying on rather extensive tests of the most promising plants, and some very successful results have been obtained. For the most part the planters had not acted upon the practical suggestions which they had received, largely because of the cost of the required seed and also on account of the extra labor involved. There is scarcely any portion of these States where a winter pasture crop, especially one of a leguminous nature, would not pay through the increased fertility of the soil and the better condition of the sod. The results of these studies will appear in a report now in preparation which will embody results of field work by Mr. Ball in Louisiana and by Mr. Combs in Florida.

EXTERMINATION OF JOHNSON AND OTHER NOXIOUS GRASSES.

Under instructions from the Agrostologist an expert was sent to the Gulf States to make an investigation of the problem of exterminating Johnson grass. To this end 15 acres of land were secured in the black waxy lands of east central Texas and a series of experiments inaugurated for the purpose of demonstrating the most economical and effective methods of destroying this pest in cultivated fields. At the same time full investigations of its relative value and the best means of utilizing it as a hay and pasture crop were made. It was found that in those States where it had been longest introduced planters had become thoroughly familiar with it and were able to successfully control it on their plantations, at the same time making free use of it as a hay crop, for which purpose it made the land fully as remunerative, acre for acre, as the best cotton lands of the rich river bottoms. The first problem to be solved in connection with Johnson grass is the prevention of its rapid spread by means of seed carelessly and needlessly scattered over wide areas. This matter lies largely with the farmers themselves, and when once they are fully awake to the necessity of doing this the problem of control and of extermination, where desirable, will be comparatively easy of solution, and at the same time an exceedingly valuable hay crop will have been added to the agricultural resources of the Southern States.

Crab grass has become a serious pest in the lawns of the Middle and Southern States. It has been particularly aggressive on the newly made lawns of the Department grounds this season, and vigorous measures are being adopted to destroy it.

HERBARIUM WORK AND COLLECTIONS.

The work on the collections and herbarium has been placed in the immediate charge of Mr. Elmer D. Merrill, and there has been a marked improvement in the condition of collections and a very satisfactory growth. The arrangement of the herbarium has been changed from the sequence of Bentham and Hooker to that of Engler and

Prantl, and the old and much-worn genus covers have been replaced by new ones. During the year 5,208 specimens have been added to the herbarium, 1,776 of which were received through the National Museum; 4,054 specimens of grasses have been determined, most of these having been sent to the Department for identification; and 1,669 specimens have been distributed to educational institutions. The herbarium forms the basis of the more technical investigations carried on in the office of the Agrostologist, and the results of studies of the collections during the past year have been made the subject of two bulletins and six circulars. In these publications 77 new species and varieties are described. The North American species of the genus *Stipa* are now being revised by Mr. E. N. Wilcox, a scientific aid in the office, and all our North American material of the genus *Paspalum* is in the hands of Mr. George V. Nash, of the New York Botanical Garden, who is engaged in a revision of that genus under commission from this office. Preliminary work has been done on a proposed index to the North American *Gramineae*, to include a full synonymy, and at present about 3,000 cards have been completed. Some work has been done on a monograph of the grasses of Alaska for the report of the Harriman expedition, and a monograph of the New England species of the genus *Panicum* has been prepared and published in a New England botanical journal.

One of the most valuable collections received during the year is a collection of the grasses of Chile. This comprises some 500 species, representing the grass flora of that country, and especially the types or typical material of nearly all the species described by R. A. Philippi. This valuable collection is to form the basis of a monograph of the grasses of Chile, to be prepared by the Agrostologist, and is to be returned to the University of Santiago, Chile, on completion of this work.

PUBLICATIONS.

During the year this office has issued 6 bulletins, 6 Farmers' Bulletins, 13 circulars, and 4 papers from the Yearbooks of the Department. The bulletins, one of which is a reprint, revised, discuss fodder and forage plants; studies on American grasses; and a revision of the North American species of *Bromus* occurring north of Mexico. The Farmers' Bulletins issued are reprints, for which large demands have been made, and discuss Southern forage crops; millets; alfalfa, or lucern; meadows and pastures; and cowpeas. The circulars discuss the following subjects: Turkestan alfalfa; agrostological notes; grasses and fodder plants on the Potomac Flats; the grasses in Elliott's "Sketch of the botany of South Carolina and Georgia;" new or little-known grasses; bermuda grass; some Arizona grasses; range-grass and forage-plant experiments at Highmore, S. Dak.; report of progress; the cultivated vetches; *Aristida purpurea* Nutt. and its allies; publications of the Division of Agrostology; cooperative grass and forage plant investigations; collection and distribution of grass seed; and field work. The papers prepared for the Yearbooks discuss grasses as sand and soil binders; progress of economic and scientific agrostology; succulent forage for the farm and dairy; and our native pasture plants.

PAN-AMERICAN EXPOSITION.

In addition to the grass garden established on the exposition grounds and already referred to, the office has spent some time in the

preparation of an exhibit of grasses and forage plants in the north wing of the Government building assigned to the Department of Agriculture. This exhibit consists of a large series of photographs illustrating the grasses and forage plants and general features of various parts of the country where forage problems are being discussed. A series of 60 transparencies, 11 by 14 inches, contained in a specially constructed cabinet, illustrates similar subjects. In three double pavilions are exhibited a number of forage plants and grasses on panels similar to those exhibited in Paris last year. There are 18 of these panels, and the plants exhibited include range grasses, pasture grasses, grasses used as sand binders, saltbushes, and various leguminous plants used for forage. In the same case are exhibited a set of seeds of native grasses and forage plants numbering some 90 varieties.

The outside exhibit on the grounds, or the grass garden, is located just east of the Government building and south of the live stock pavilions. It is the first attempt of the kind to exhibit so large a series of agricultural grasses and fodder plants, and in spite of some difficulties in the way of inferior soil, lack of proper drainage, and lateness of the season, due to protracted spring rains, the exhibit is a very creditable one. A unique feature in this exhibit is a sand dune, artificially prepared, upon which are growing grasses native to the sands along the Pacific coast, along the Atlantic seaboard, the shores of the Great Lakes, and the sandy deserts of Wyoming and Idaho.

REPORT OF THE POMOLOGIST, G. B. BRACKETT, ON WORK OF THE YEAR.

ROUTINE WORK.

In consequence of the responsibility laid upon this office in directing the horticultural exhibit of the United States at the Paris Exposition of 1900, the routine work of the year has been especially heavy. This was particularly true with regard to correspondence, that relating to exposition work having continued heavy until after the middle of the fiscal year. At the same time the correspondence relating to the regular work has shown the usual increase. The number of letters written was more than 25 per cent larger than in the previous year, while a large volume of routine correspondence was conducted by means of circulars.

As in former years, the examination and reporting upon the large number of specimen fruits received by mail for various purposes occupied the time and attention of several persons during the ripening season. About 1,800 lots of fruit have been thus passed upon, nearly 700 lots having been sent by growers for identification. It is gratifying to note that, notwithstanding the wide geographical range represented by these specimens, more than two-thirds of them were satisfactorily identified and the senders duly informed concerning the correct names of the fruits grown by them. This is of much importance to those who desire to extend their plantings of varieties that have been found adapted to their localities but are of unknown identity, as well as to those who have found that certain varieties in their orchards are worthless there and should be avoided in new plantings.

The increasing number of persons who consult the office in this way indicates the importance of the work to the practical fruit grower. The receipts of the past year include practically the entire range of

fruits grown in the continental area of the United States, together with specimens from eight foreign countries.

About 500 technical fruit descriptions have been added to the files during the year, together with about 300 accurate water-color paintings and 240 facsimile models, in addition to 270 duplicate models prepared for exhibition at the Pan-American Exposition. About 200 mounted herbarium specimens and a considerable number of photographic negatives have been added to the collections.

DISTRIBUTION OF TREES, SCIONS, CUTTINGS, PLANTS, AND SEEDS.

In continuation of the cooperative work with the Office of Seed and Plant Introduction, a larger number of promising varieties of fruit-producing species—about 400 varieties, representing about 50 species—has been received and distributed than in any previous year. These distributions comprised more than 200 varieties of the apple, received from French, German, Swedish, and Australian, as well as domestic sources; nearly 70 varieties of the plum, chiefly of the prune and mirabelle types, from France, Germany, and Austria, and 27 varieties of grapes, mostly foreign.

Through the agency of the comprehensive list of voluntary correspondents, which has been systematically developed, revised, and enlarged, such material of this kind as now reaches the Department at almost any time of year can be promptly placed in the hands of intelligent propagators, where it can receive a careful and thorough test to determine its relative value without loss of time. It thus requires but a small expenditure for stock of a promising new foreign variety or species to insure its wide distribution in regions suitable for determining its probable commercial usefulness.

FRUIT EXHIBIT AT THE PARIS EXPOSITION.

The continuous fruit exhibit at Paris, referred to in the report of the previous fiscal year, was maintained without intermission until the close of the exposition, October 31, 1900. As a precautionary measure a sufficient supply of apples of the crop of 1899 had been provided in that year to insure a continuous display of this fruit throughout the exposition, even if the crop of 1900 had entirely failed. The crop of 1900 having proved to be of fair quality and quantity, taking the country as a whole, the reserve stock of 1899 was crowded forward to the exposition tables as rapidly as possible, where it was largely replaced during the last half of the exposition period by fruit of the current crop. Enough of the old fruit was reserved to maintain a continuous show, however, and to provide against any probable emergency, such as the failure of a shipment to reach Paris at the appointed time.

Four shipments of fruit of the crop of 1900, embracing 265 varieties of apples, 130 of pears, 16 of peaches, and 58 of plums, from 15 States, were made in August, September, and October. After a thorough preliminary investigation it was considered possible, with existing transportation facilities, to forward such shipments from New York to Paris in an average time of not less than ten days, and the shipments were arranged for on that basis. It is gratifying to record that none of the four shipments made was longer than ten days in transit, while that which contained the largest quantity was delivered at the exposition eight days and nineteen hours after leaving New

York. With but very few exceptions these fruits, even peaches and plums, carried well and reached their destination in excellent condition. The exhibit continued to arouse great interest among visitors at the exposition, and frequent inquiries were received for sources of commercial supplies of American apples, oranges, and pecans.

The awards made to American exhibitors in this class (No. 45 of the exposition classification, "Fruit trees and fruits") were merited by the quality of the products shown. These were 106 in number, comprising 6 grand prizes, 23 gold medals, 39 silver medals, 31 bronze medals, and 7 honorable mentions, a total of more than 20 per cent in excess of the awards to any other foreign country.

The ultimate beneficial effect of this exhibit upon the future of our export trade in fresh fruits can hardly be overestimated, as the magnitude and duration of the display afforded convincing proof to dealers and consumers of the practicability of handling many kinds of American fresh fruits in European markets. Taken in connection with the fair crop of winter apples in the Northern States and the large crop of oranges in California, it may reasonably be credited with a share of the gratifying increase shown in the exports of these fruits during the year just closed.

Exports of apples and oranges for the fiscal years 1899-1901, inclusive.

Year.	Apples.		Oranges.
	Barrels.	Value.	Value.
1899.....	380,222	\$1,210,459	\$282,313
1900.....	526,636	1,444,655	271,468
1901.....	855,673	2,058,964	436,560

INVESTIGATION OF THE PRUNE INDUSTRY IN EUROPE.

As a result of the rapid development of commercial prune culture in the Pacific Northwest (Oregon, Washington, and Idaho) in recent years, some serious problems have been encountered, which have appeared at times to threaten the future of the industry. Prominent among these has been the difficulty experienced in producing a product of uniform quality with the existing methods of harvesting and curing.

This difficulty is greatly increased by the fact that the variety chiefly planted in the region referred to—Italian prune, synonym *Fellenberg*—ripens rather too late for good harvest weather in many sections where large prune orchards have been planted, and is frequently injured in quality and reduced in quantity by the occurrence of early autumn rains. The most promising remedy for this condition appears to lie in the line of originating or discovering a variety possessing the desirable qualities of the Italian and ripening a week or ten days earlier. With a view to determining whether a variety possessing the desired characteristics is known in the prune-growing sections of Europe, Prof. E. R. Lake, of the Oregon Agricultural College and Experiment Station, was, upon my recommendation, appointed a special agent on the roll of the office of the Botanist, with instructions to investigate this question in France, Germany, and Austria, the chief sources of the European supply of choice prunes. This he accordingly did during the summer and autumn of 1900, in the three countries mentioned,

making careful observations of the varieties grown and methods followed in the culture, curing, and marketing of this crop. Professor Lake secured trees and scions of a number of varieties of prunes and mirabelle plums that promise to be of value in various sections of the country. These have been placed with a number of careful experimenters for trial. An interesting report on the methods of growing, curing, and marketing of prunes in the countries visited by Professor Lake in the course of this investigation is now in press and will soon be issued as a bulletin of this office.

EUROPEAN TABLE GRAPES IN SOUTH ATLANTIC STATES.

The small experimental vineyards of European table grapes on resistant stocks in Florida and North Carolina have been maintained during the year. That at Earleton, Fla., continues to give promising indications of ultimate success in the effort to introduce the culture of this delicious fruit into sections where the winters are mild and the rains at the ripening time not excessive. The remarkably vigorous wood growth of most varieties on resistant stocks at Earleton leaves little doubt regarding the congeniality of the climate in that respect, and an abundant crop of fruit set on the two-year-old vines of many varieties in the vineyard testified to their productiveness under the methods of fertilizing, pruning, cultivating, and spraying practiced there.

Some trouble from mildew and black rot was experienced this season, but not more than may be reasonably considered within the range of control by modern spraying methods. The most serious difficulty experienced there this year was the effect of the unusually heavy and long-continued summer rains. These began in May, much earlier than usual, and continued through June and July with little intermission, causing much bursting of fruit about to ripen. Owing to the lateness of the opening of spring in the South this year the injury to the fruit was probably disproportionately large, as the rains came on before any but the very earliest varieties were ripe. Notwithstanding this, several varieties have given evidence of distinct value for Florida and adjacent sections. These will be propagated on resistant roots for further experimental distribution.

The North Carolina vineyard is in less promising condition. It suffered from the effects of the severe drought of the summer of 1900, and again during the present season from an epidemic of black rot, which was not controlled by the spraying methods practiced, either on the vinifera vines or the large commercial vineyards of Niagara in the same region. The problem of disease control will receive special attention at this vineyard during the present fiscal year, and it is hoped that in cooperation with the Pathologist and Physiologist methods of treatment may be devised through which this disease may be more successfully combated there. Fruit of a considerable number of varieties was successfully matured, however, at this vineyard, and several sorts are considered very promising for further test.

Some of the newly introduced Franco-American hybrids of European and American grapes, designated "direct producers" by the French, promise to have distinct value in the South, and will be distributed for testing in other grape-growing sections. These hybrids, while producing fruit of good quality, are at the same time resistant to Phylloxera, thus rendering the grafting process unnecessary in vineyard practice.

NUT-PROPAGATION EXPERIMENTS.

In an effort to discover some practicable nursery method of propagating walnuts and hickories in the Middle and Northern States, certain experiments in greenhouse propagation were undertaken with the Persian walnut, the pecan, and two species of hickory.

The essential feature of these experiments, which were planned and carried on by Mr. William P. Corsa, of this office, consisted in the control of conditions of temperature and humidity during the period when the newly set grafts were undergoing the callusing process. At the same time special precautions were taken to protect the newly grafted trees from injury by certain insects and fungi which thrive at the relatively high temperature considered necessary for successful callusing of these species.

The stocks used were mainly one-year-old seedling trees, and several allied species were tested under similar conditions for each kind of scion used. These were planted in pots after being grafted and callused, and were permitted to start and continue in growth until the climatic conditions warranted their transplanting to the open ground in early May. Up to this point the results obtained were, on the whole, encouraging. Later developments in the open ground considerably reduced the proportion of successful grafts, apparently through the destructive effect of the intense heat of the sun upon the newly planted grafted trees.

The experience gained in these experiments will be utilized in future work along similar lines, as the subject is considered one of great importance in view of the growing interest in nut culture in the United States.

CARD CATALOGUE.

The work on the card catalogue of fruits has been continued during the year by Prof. W. H. Ragan, who has it in charge.

The varieties of the important tree fruits and grapes in the standard pomological works published in America having been catalogued, the listing of such varieties as have been listed or described only in nursery catalogues, horticultural periodicals, horticultural society reports, and similar publications has now been taken up.

EXHIBIT AT THE PAN-AMERICAN EXPOSITION.

The exhibit prepared for the Pan-American Exposition by the office consisted of four distinct features:

(1) A comprehensive collection of fruit models, illustrating the more important varieties of the several fruits grown in the United States. This consisted of more than 1,000 specimens, representing about 850 named varieties belonging to 62 distinct botanical species.

(2) An exhibit illustrating the standard commercial grades of apples as adopted by the National Apple Shippers' Association and now generally recognized throughout this country and Canada in commercial transactions in this important fruit.

(3) A collection of named varieties of pecans from the Gulf States.

(4) A collection of photographs illustrating certain characteristic features of the horticulture of the United States.

As the material for this exhibit is drawn largely from the working collections of the office, and as the work of preparation and instal-

lation was done entirely by employees of the office, the actual expenditure of exposition funds was very small.

In view of the fact that this work seriously interferes with important lines of investigation in progress, I would strongly recommend that for future expositions a sufficient allotment of funds be provided to make possible the preparation of suitable exhibits without encroaching upon the regular and urgent work of the office.

CURRENT WORK.

Under the reorganization of the Department, through which the Division of Pomology becomes a part of the newly organized Bureau of Plant Industry, it is expected that the work heretofore done by that Division will be carried forward without radical change. As the regular routine duties of the office may be expected to increase even more rapidly in the future than has been the case in the past, it is imperative that an additional increase of the working force be provided to keep pace with it.

Such pomological exhibits as are to be made at the St. Louis Exposition of 1903 will need to be planned and carried well toward completion during the present fiscal year, as the uncertainty regarding supply of suitable material at the exact time needed is greater in this line than in any other branch of the Departmental work.

In view of the increased appropriation for pomological investigations for the present fiscal year, and the authorization of certain lines of work recommended in the report of last year which require extensive field investigation and experimental work, these special lines of investigation have been placed in charge of Mr. William A. Taylor, the former assistant pomologist, who is now designated pomologist in charge of field investigations. Under his direction the work of investigating market conditions affecting the domestic and export trade in fruits and vegetables, the continued effort with European grapes in the South, and the mapping of commercial fruit districts will be prosecuted as rapidly as the circumstances and the appropriations available will justify. It is intended that the investigation in each of these lines shall be in immediate charge of an expert, who shall familiarize himself with the details of the work in that line, and who shall, so far as is possible under the circumstances, concentrate his efforts during the greater part of the year upon that particular subject.

The investigation of methods of harvesting, transporting, storing, and marketing fruits will naturally take precedence of other lines during the present year. Plans are being made under which it is expected that fruit growers will cooperate with the Department in making such experimental export fruit shipments as seem advisable to determine the facts regarding sizes and styles of packages, methods of wrapping and packing, character of transportation (including refrigeration), and other points concerning which there is disagreement among shippers. As now outlined, the experimental work of the present season will be devoted especially to the apple and pear, both in the export and the storage experiments, these being considered the most important fruits in the export trade at the present time.

The European grape work in the South will be conducted along the line previously followed, namely, that of endeavor to bring to light varieties yielding fruit of fine table quality, which when grafted upon resistant stocks and protected from leaf and fruit diseases by spray-

ing may be expected to succeed in our Southern States. Special attention will also be given to the problem of Phylloxera-resistant stocks for the Pacific coast and to direct producers suited to Eastern grape districts.

The mapping of fruit districts will be based at the outset upon the recorded experience of growers, reinforced and corrected by careful field investigation by experts, and shaped so far as possible to conform to the topographic and geologic map work already done by the United States Geological Survey and the soil maps now being prepared by the Bureau of Soils of this Department.

EXPERIMENTAL GARDENS AND GROUNDS.

WORK OF THE YEAR.

The work has been directed during most of the year by the chief of the Bureau, but recently the details have been put in charge of Mr. L. C. Corbett, horticulturist of the Department. Mr. Corbett submits the report, setting forth the progress of the work of this branch.

The general scheme of work outlined in the last annual report by the Director of Plant Industry has been put into effect, and the close cooperation of this branch with that of Plant Physiology and Pathology, Agrostology, Pomology, Botany, and Seed and Plant Introduction has become a reality.

DISTRIBUTION OF PLANTS, BULBS, ETC.

During the year the customary distribution of plants has been maintained, the records showing that the following sorts, to the number indicated, have been distributed:

Distribution of bulbs, plants, etc., 1900-1901.

Bulbs, consisting of hyacinth, tulip, crocus, narcissus, Japan lily, tube-rose, etc. (Congressional distribution)	113,835
Bedding plants	20,000
Camphor plants	795
Fig cuttings bundles	1,087
Fig cuttings	1,600
Ginkgo trees	701
Grapevines (Congressional distribution)	19,937
Miscellaneous plants, including Ampelopsis, Citrus trifoliata, cinnamon, coffee, currant, guava, palms, pepper, pineapples, privet, rubber plants, vanilla, etc.	4,076
Olives	355
Ponies	500
Phlox	500
Privet cuttings	5,000
Strawberry plants (Congressional distribution)	66,843
Tea plants	1,433
Tea seed pints	18
Willow cuttings	2,500
Young shrubs (miscellaneous)	2,000
Young trees	1,800

Much time has been devoted to the pruning of shrubs and trees about the grounds. The growth of others has made the removal of some specimens necessary in order to preserve those of most value. In all cases, when the future preservation of rare and valuable specimens has been involved, such crowding trees have been removed.

PLANTING.

A large number of annual bedding plants have been placed about the grounds, with the result of adding very considerably to the general effect. Besides the planting of annual bedding plants the collection of ornamental shrubs upon the grounds has been somewhat enlarged.

ECONOMIC COLLECTION.

The plants which supply food for man or which are used by him in the arts are at present well represented in the economic collection in the conservatories. This collection, which is already one of the most complete in America, is constantly being added to by introductions from our new possessions, as well as from foreign countries. In building this collection cooperation with the Office of Seed and Plant Introduction has proved very helpful.

PLANT PROPAGATION.

Besides the work of propagating new and rare plants brought in through the Office of Seed and Plant Introduction, a number of plants of the classes named are being grown for use upon the grounds and for dissemination, as follows:

New and rare plants grown.

BEDDING PLANTS ON GROUNDS.

Abutilon	300
Acalypha	100
Alternanthera.....	2,200
Canna	150
Coleus (in variety)	2,900
Cuphea (in variety).....	100
Geraniums (in variety).....	1,400
Iresine	800
Salvia	600
Total.....	8,550

FLOWERING PLANTS ON GROUNDS.

Aster	500
Bouvardias	250
Dahlia	100
Dianthus	350
Feverfew	250
Gladiolus	350
Marguerite	350
Rudbeckia	600
Roses (in variety)	2,200
Total.....	4,950

TREES AND SHRUBS ON GROUNDS.

Evergreens	85
Miscellaneous shrubs	100
Young shade trees	50
Total.....	235

PLANTS IN NURSERY PROPAGATED FOR STOCK AND SPECIAL DISTRIBUTION.

Abutilon	1,500
Ageratum	800
Alternanthera	6,000
Begonia	600
Carnation	4,000
Chrysanthemum	2,500
Coleus	6,500
Cuphea	700
Dahlia	250
Geranium	3,000
Geranium (scented)	500
Iresine	4,000
Rose	4,000
Salvia	1,500
Butternut	230
Black walnut	335
English walnut	150
Olive	2,200
Pecan	375
Pecan (Miller seedlings)	120
Pecan seedlings, improved sorts	7,000
Apple seedlings	100
Grape	30,000
Calycanthus floridus	25
Catalpa	200
Chionanthus virginica	30
Elm (American)	175
Ginkgo biloba	59
Ginkgo biloba (seedlings)	7,500
Linden (American)	65
Maple (black)	85
Maple (silver)	60
Maple (Norway)	110
Oak (pin)	65
Oak (willow)	5
Tulip	13
Willow	2,000
Yellow wood	225
Total	86,977

SPECIAL CROPS.

The two special crops which are now under study are roses and carnations. The object of the work with these plants is to develop improvement in cultural methods which will render the cultivation of these crops more remunerative to commercial growers. This work involves a study of soil conditions and light and heat requirements, as well as the structure best suited to secure these conditions.

PLANS FOR FUTURE WORK.

The aim in the management of the grounds will be to maintain typical specimens of each of the various hardy trees and shrubs adapted to lawn planting in this climate. This collection is already one of the best in the country, but additions are needed from time to time to make it complete. As an addition to the collection of ornamental plants, it is proposed to devote considerable area to introduced hardy herbaceous annuals and perennials, and to arrange them for landscape effect, rather than according to their botanical affinities. It is believed that such a collection will demonstrate the value of our native, and at present neglected, plants, and enable many flower lovers, whose income

will not admit the purchase of rare and beautiful plants, to produce equally as pleasing effects without cost and with the expenditure of a minimum amount of labor.

The study of special crops and their requirements will be made a still larger feature of the work as soon as facilities for its prosecution can be provided. This will include the commercial crops grown by the florist, such as roses, carnations, violets, etc., and vegetables, such as lettuce, radishes, tomatoes, cucumbers, etc., which form important commercial crops during the winter months.

We now have in our collection many plants which are of more than ordinary interest and value, because they are the parent stock from which an industry has sprung up. The Washington navel orange may be noted as an example. The unusual interest which centers about plants of this kind is sufficient reason for justifying the expenditure of time and money in their preservation, and to this end a house will be erected in which such interesting specimens may be cared for.

With the growing interest in the cultivation of the European grape on resistant stocks, both in Eastern and Western America, it seems desirable that the collection of varieties of this class now at the Department be considerably increased. It is therefore the purpose to collect such varieties as show desirable qualities and test them in pots in the greenhouse, not only to afford material for studying the sorts, but in order that a supply of wood for grafting may be easily available.

ARLINGTON EXPERIMENTAL FARM.

WORK OF THE YEAR.

LOCATION AND CHARACTER OF THE FARM.

The work of the Arlington Experimental Farm is conducted under the office of the chief of Bureau, with Mr. L. C. Corbett in direct charge. The farm is that portion of the former Robert E. Lee estate between the Arlington National Cemetery Reservation and the Potomac River. It can be reached by either of two lines of electric cars in twenty minutes, or by carriage.

The plot set aside for experimental use consists of some 400 acres of rolling land, made up chiefly of a clay loam, underlaid at a depth of 3 to 5 feet with an impervious clay subsoil, except the tops of the knolls, which consist largely of gravel. As a whole, the land lies well for the purposes to which it is to be devoted. In mechanical condition, it is all that could be desired—it is easily cultivated, responds readily to good treatment, yet carries a sufficient amount of sand to allow of cultivation soon after heavy rains. In general, it is in a fair state of fertility, the more elevated portions alone showing a lack of available plant food; this, however, will be corrected by the use of green manures and mineral fertilizers before permanent plantings are made. The diversity in the surface provides suitable locations for the various fruits adapted to this latitude, as well as facilities for studying the influence of slight elevations upon frost zones.

Since this parcel of land came under the control of the Department it has been thoroughly grubbed, all brush, briars, and tree growth having been removed, thus fitting the ground for the work of draining and cultivation.

DRAINING.

Several large streams of water reach the boundary of this property from the Arlington National Cemetery. These streams are too large

to be carried either in drain tile or large-size sewer pipe, and accordingly open ditches have been dug to serve as mains for these streams and to carry off the flow from tile drains rendered necessary by the great number of springs which are at present near the foot of the slope of the hill, particularly in the southwestern part of the farm. In order to drain this springy land and fit it for cultivation, some 10,000 feet of 3-inch and 4-inch drain tile have been laid. In carrying on this work it has been the object not only to carry off superfluous water, but to do the work in such a manner that the soil would be aerated and sweetened.

BUILDINGS.

A shed which serves the purpose of stable and tool room has been erected. There are no other structures of any description on the place.

CULTIVATION.

Plows were started in May, and some 40 acres have been prepared and seeded with cowpeas.

PLANS FOR FUTURE WORK.

It will be the aim to develop the Arlington farm into a high-grade experiment station for the purpose of propagating, testing, and studying fruits, vegetables, grains, and other crops brought to the attention of the Department. Besides investigating the needs of the soil with reference to the growth of fruits and vegetables, plots will be provided for the use of the various branches of the Department carrying on work in connection with plant diseases, insect attacks, etc. The Department has long felt the need of a collection of fruits, vegetables, and other plants, where experiments of this nature could be conducted, and one object of this work will be to provide these facilities as rapidly as possible. Within recent years a great many valuable seeds and plants have been sent to the Department, which, owing to lack of proper facilities for handling and growing, have been lost. All such seeds and plants will be tested in a preliminary way on the experiment farm, and all those that are found valuable will be disseminated where they give promise of succeeding. It is planned to do this work largely through the State experiment stations and through private individuals who have shown an interest in such special investigations.

In cooperation with the office of the Agrostologist, areas for testing the uses of various new forage plants will be set aside; and in order to facilitate the work in plant pathology and physiology, commercial fruit plantations will be maintained in which hybrid and cross-bred sorts will be tested, diseases treated, and food requirements studied. In order to obtain these results several years will be required. Buildings must be erected, and the working force of unskilled workmen must gradually be changed into a force of experts.

EXPERIMENTS IN PRODUCTION OF TEA.

WORK OF THE YEAR.

The experiments in the production of tea have been conducted, as heretofore, at "Pinehurst," Summerville, S. C., under the direction of Dr. Charles U. Shepard. The work during the year has been mainly directed toward the cheapening of the cost of production, the

improvement of the quality of the product, and the determination of the relative adaptability of the various sorts of tea for profitable cultivation in this country. In order to satisfactorily carry out this line of work, it became necessary to clear and put in suitable order considerable tracts of land for the extension of the experiment gardens. This has been done to the extent of about 12 acres, three-fourths of which have been finished and planted in tea. An additional 5 acres had been previously prepared, but the imported seed with which it was designed to plant it failed to germinate. Work is now being done on the preparation of 3 or 4 acres more. On the completion of this work it is intended to stop further extensions. This accession of practically 20 acres of land is designed for testing the feasibility of dispensing with artificial enrichment, the cost of which has constituted 15 to 20 per cent of the total expense of tea production. It is also planned to utilize the ground to some extent for cultivating imported varieties of tea of acknowledged worth. Until recently all of the "Pinehurst" gardens had been stimulated with artificial manuring. During the year a number of consignments of oriental tea seed were received, but owing to the long time necessary in transporting this seed much of it failed to germinate. The receipt of this seed has enabled the Department to establish four tea gardens at "Pinehurst," two of which are chiefly from seed from 2,000 feet and one each from 4,000 and 5,000 feet, respectively, above sea level. Of all the seed imported, that obtained from Darjeeling, in British India, produces the largest, surest, and most valuable tea crop at "Pinehurst." The crop of tea from the gardens this year will aggregate about 4,500 pounds, which is a slight gain for the whole estate over any previous year. It further demonstrates the fact that the plants which were so severely cut down by frost in the phenomenal freeze of 1898 have entirely recovered.

During the year special attention has been given to the development of machinery to aid in handling the tea. It becomes apparent as the work progresses that machinery will be absolutely essential in order to compete with the cheap labor of the Orient. Special machines used in the tea factories of the British colonies have been procured during the year and found to work very satisfactorily. As a result of the improvement in mechanical equipment the quality of the tea has been uniformly better, which is a very encouraging and promising result. Aside from the advantages already enumerated to be secured from the use of machinery, measures of equal importance are to be noted—as, for example, the elimination of possibilities of uncleanness, and even of disease, from the hands of persons who handle the tea. Very satisfactory results have been obtained during the year through the introduction of the "rotary witherer." The mechanical manufacture of black tea has been in extensive use for several years, but only recently has that of green tea been seriously attempted. It has seemed all the more desirable, as this country is the chief consumer of that commodity; but so long as its preparation was entirely by hand its profitable production in the United States would have remained impossible. This new machine, which was invented by Dr. Shepard, has successfully overcome many of the difficulties of handling tea, and has paved the way, in conjunction with already supplied rolling, sifting, and dyeing machines, for the manufacture of green tea in a clean, cheap, and uniform manner. By means of the machine invented by Dr. Shepard a sterilization of the solvent ferments of the tea leaf is effected, so that its oxidation is reduced

to a minimum. Dr. Shepard has very generously arranged to patent this machine in the name of the Government, and will offer it through the Department to future American tea makers without royalty or restriction.

During the year the experiments in irrigation were continued, with encouraging results, although an accident to the main supply of water temporarily interfered with the extension of the work on a large scale. The experiments in sheltering tea from the direct sunlight have shown that the product obtained in this way is of a very much higher quality, but that the production was slightly decreased. Further work along this line is necessary to prove the profitable features of the investigation.

The expense of the work conducted by Dr. Shepard has been, in large part, borne by himself, and as a result of his efforts he has now at "Pinelhurst" about 100 acres in tea, a well-equipped factory capable of turning out about 150 pounds of dry tea daily, and a disciplined force of tea pickers and factory hands. This well-conducted establishment, to the building of which Dr. Shepard has given some of the best years of his life, is now in position to serve as a model and school of instruction in the industry to which it is devoted.

PLANS FOR THE FUTURE.

In order to extend the work of tea production in the United States it will become necessary to establish seed-bearing groves in different parts of the Southern States. This is essential from the fact that better seed can be obtained from such groves than from the much-pruned and leaf-plucked commercial tea gardens. By means of a few acres of widely separated tea groves an abundance of tea seed of distinct character might be raised for the supply of future American gardens. As rapidly as the means will permit, it is planned to train young men (graduates of agricultural colleges) in the matter of tea production and to extend the work to different parts of the South where climate, soil, and labor give promise of success. There is much yet to be done in determining the best methods of handling tea, and for this reason it is believed advisable to secure, if possible, the services of a competent tea expert. Steps are being taken to this end, and it is hoped to have such an assistant at an early day.

SEED AND PLANT INTRODUCTION.

WORK OF THE YEAR.

On March 1, 1901, Mr. Jared G. Smith, who for a year past had been conducting the work, was appointed special agent in charge of the Hawaiian experiment station, at Honolulu, and Ernst A. Bessey was transferred from the Division of Vegetable Physiology and Pathology as assistant in charge. This report has been prepared by Mr. Bessey.

During the year 1900-1901 the number of importations of seeds and plants by the Office of Seed and Plant Introduction was about 1,614. The actual number of varieties is less than this, for many varieties were imported a number of times and from several different localities. A large part of these importations has been distributed to experiment stations and to a few private experimenters. As far as possible, seeds of the more important tropical and subtropical plants, especially those received in small quantities and those whose value is still problemat-

ical, have been planted in the Department greenhouses. It was also attempted to keep a sufficient number of every importation of live plants or cuttings, or, if the importation was small, the whole number, to furnish next year a larger number for distribution, besides preventing any danger of losing the whole importation, as might occur if the cuttings arrived and were sent out at an unfavorable season of the year. Many live plants and cuttings are not in the best condition after a long voyage, and it is advantageous to keep them where they can receive good care before sending them out.

During the year there have been four explorers collecting plants from foreign countries. Mr. M. A. Carleton, upon the completion of his work on the jury judging cereals at the Paris Exposition, went to Russia and obtained a quantity of macaroni wheat, and also of the hard red spring and winter wheats especially suited for cultivation on the Great Plains. Mr. G. D. Brill, an American citizen, for some time previous a resident of Wuchang, China, made a collection of seeds and plants in China, mainly in the Yangtse Vall y. A large number of pear, apple, and peach trees collected by him were dead when they reached Washington, having been delayed in transit. Mr. Brill's work was considerably hampered and his proposed itinerary very materially changed by the Boxer outbreak.

The main explorations of the year were those conducted by Mr. David G. Fairchild. In September, 1900, he was sent to Germany and Austria, especially to obtain hops and barleys, but also with instructions to obtain anything else of value that he might observe. Later he was instructed to proceed to Greece and Egypt. The last two months of the fiscal year were spent by him in Algeria, making arrangements to obtain some of the best varieties of Algerian macaroni wheats and Algerian forage plants. In this work he was ably assisted by Mr. Carl S. Scofield, assigned for that purpose temporarily to this office.

As in previous years, this office has cooperated with various branches of the Department in the matter of obtaining seeds and plants for various purposes. In cooperation with the Division of Chemistry, the purchase and distribution of sorghum and sugar-beet seed were undertaken. These were sent to the experiment stations in the States suited to their culture, as determined by the observations made by the Division of Chemistry, and were also distributed in those States through Senators and Representatives. A considerable quantity was also sent out on personal application, and toward the end of the planting season the remainder of the seed was distributed to the crop reporters and county correspondents by the Division of Statistics. In cooperation with the Pomologist, a large collection of apple and plum trees was obtained from Europe, and in cooperation with the Pomologist and the Pathologist and Physiologist, a collection of apple trees and scions of resistant varieties was obtained from Australia for experimental work against root aphid and root rot, respectively. In the introduction of macaroni wheats the office has worked in cooperation with the Office of Vegetable Physiology and Pathology, the wheats having been obtained by Mr. M. A. Carleton, cerealist of that office.

As provided by the act of Congress making the appropriation, the seeds and plants imported have, to a large extent, been sent to the experiment stations for trial. In many cases, instead of sending direct to the stations, the importations were sent to parties desig-

nated by the stations. The attempt has been made in every case to put the plants in parts of the country thought to be probably fitted for their growth, and they have been given as wide a dissemination as possible. It has been the attempt, moreover, not to send seeds and plants to people unknown to the Department or to the experiment stations unless it is apparent that they are able to report intelligently upon the experiment.

In two cases, namely, macaroni wheat and Turkestan alfalfa, where it has been shown that these importations are of great value, contracts have been entered into with several parties for growing seed, these to be purchased by the Department, subject to action of Congress in appropriating money available therefor.

The more important introductions of the past year are mentioned below.

In Bohemia Mr. D. G. Fairchild obtained several of the best varieties of hops. It is well known that the American hops are far inferior for brewing purposes to some of the Bohemian varieties, and several thousand cuttings of the latter were accordingly obtained, among them the Saaz, Semsch, and Tettwang varieties, and were placed, through the cooperation of the experiment stations, with experienced hop growers, mainly in the States of New York, Washington, Oregon, and California. At the same time Mr. Fairchild obtained a quantity of the best varieties of brewing barleys, particularly the Hanna barley. These, too, have been distributed where barley growing is practiced especially, and ought to prove of great money value to the country.

The little town of Malin, in Bohemia, is famous all over Europe for the especially fine horseradish which is produced there. Mr. Fairchild was fortunate enough to be able to obtain a large number of cuttings of its best variety, and these have been distributed to horseradish growers in the country. It is too early yet to determine how valuable this importation will prove to this country.

From southern Austria and Greece a few cuttings of a number of the more valuable wine and table grapes were obtained. When these are grown in sufficiently large numbers in this country they ought to prove a valuable addition to our already considerable list of such grapes. Probably the most valuable importation of these was that of about 3,000 long cuttings of the Greek corinth from Panariti. These have been placed in parts of California and Arizona, where the climate is similar to that part of Greece from which they came; and if they prove to bear as well in this country as in their native home they will be of exceedingly great value. At present we import hundreds of thousands of dollars worth of corinths, or Zante currants, as they are called, and if they can be produced successfully in this country the importations would be greatly decreased.

Other importations of less importance from Greece include oranges, seedless lemons, limes, pomegranates, and the pistache nut.

In continuation of the importation of date palms, by which it was intended eventually to have growing in Arizona and southern California all the good varieties of dates in the world, Mr. Fairchild obtained the best varieties of dates of the Delta of the Nile, in Egypt. He also arranged to obtain palms of the best varieties grown in other parts of Egypt.

A large collection of the most important leguminous forage crops of Egypt was procured for use in the extensive experiments with these plants to be undertaken in this country the coming season. A

considerable amount of Egyptian cotton seed was obtained from different parts of Egypt for use in breeding for improved quality and for resistance to root disease. A quantity of the seed of the Berseem clover was also obtained, but not enough for a general distribution.

Among the cereals of more or less importance that were imported by the office during the year may be mentioned the North Finnish Black oats from Finland and Sixty Day oats from Russia, both especially suited by their shortness of season for Alaska and regions of short growing period, and a special strain of Ligowo oats, suited for growth in the Northern States. From Sweden there was also obtained a number of the better brewing barleys especially adapted for shorter seasons.

Importations that will prove of value for limited localities are a number of figs and caprifigs which will be valuable to California, and a considerable quantity of seed of the Siberian crab apple, which latter plant will, it is thought, be especially valuable as a stock for the apple to prevent winterkilling.

FUTURE WORK.

For the coming year, it is planned to obtain new varieties of rice from Japan, China, the Philippines, and India, in the attempt to extend the rice industry farther North, and to make it possible for the small farmers in the interior of the Southern States to obtain a rice that will prove valuable for stock-feeding purposes. In connection with this work, Dr. Seaman A. Knapp, of Lake Charles, La., is making a trip to the countries named.

It is the intention to continue the work with cereals, particularly the macaroni wheats. For this purpose several hundred bushels obtained by Mr. Fairchild in Algeria will be made use of, as well as a large quantity to be obtained in Russia. That now being grown under contract will also be distributed. It is hoped the coming year to be able to demonstrate to the farmers the practicability of growing this wheat, and thus to get its culture generally established. Already in North Dakota and South Dakota farmers are going into this matter quite extensively.

Special attention will also be paid this year, mainly in the South and on the Pacific coast, to the introduction of new forage crops, principally leguminous plants. There is great need in these regions for a variety of such crops that can be used both for forage and as green manure.

The date industry will continue to take some time and study. Desirable varieties will be imported when found, and possibly an explorer sent to Algeria to study certain features of date culture.

A nut of great value in the Mediterranean region is the pistache. A few scions of this have already been imported, but it is intended to prosecute the introduction vigorously. The nut is well worth culture in this country, and will prove very valuable when it is once established. Attention will also be paid to the plants especially adapted to our tropical possessions. Active cooperation will be maintained with the experiment stations in Porto Rico and Hawaii, and assistance will be given, as far as practicable, to agricultural work in the Philippines.

In cooperation with the office of the Pomologist it is intended to introduce new fruits into this country wherever such may be found desirable.

Fiber plants, especially cotton, will be introduced in cooperation with the office of the Pathologist and Physiologist and the office of the Botanist.

Besides the above-mentioned lines of work it is the intention of this office, as far as possible, to import seeds and plants in direct cooperation with the experiment stations, where the latter are making special studies of certain lines of work.

The increased interest in plant breeding all over the country has led to the need of obtaining small quantities of a great many varieties in the attempt to obtain desirable qualities which can be bred into the new varieties. The Office of Seed and Plant Introduction is especially favorably equipped for making such importations, and will endeavor to keep in close touch with plant breeding throughout the whole country.

The changes in the general plan of handling all the work connected with seed and plant introduction have already been discussed, and need not be entered upon in detail here. Suffice it to say that the division of labor effected by the change, and the opportunities afforded for concentration of efforts on special crops, have already produced good results.

CONGRESSIONAL SEED DISTRIBUTION.

In accordance with an order issued by you on April 24, 1901, all matters pertaining to the final settlement of the Congressional seed distribution for the fiscal year ended June 30, 1901, were placed in the hands of the chief of the Bureau. At that time the work of distributing the seeds was practically finished, but steps were at once taken to carry out your instructions in regard to closing up the work. It was found that the appropriation for the purchase and distribution of valuable seeds and plants for the fiscal year ended June 30, 1901, was \$170,000, and that the following allotments had been made of this sum:

For the purchase and distribution of vegetable, flower, cotton, tobacco, and lawn-grass seed, through the New York Market Gardeners' Association	\$108,874.12
For the purchase and distribution of valuable foreign seeds and plants, through the Office of Seed and Plant Introduction	20,000.00
For the purchase and distribution of grapevines, strawberry plants, and bulbs, through the Office of Experimental Gardens and Grounds ..	5,000.00
For the purchase and distribution of sugar-beet, sorghum, and other miscellaneous Congressional seed	3,125.88
For miscellaneous labor and material, to be expended in the city of Washington.	33,000.00
Total	170,000.00

The details of the work connected with the distribution of valuable foreign seeds and plants, and the purchase of grapevines, strawberry plants, bulbs, etc., have already been given under the reports on the work of the Office of Seed and Plant Introduction and the Office of Experimental Gardens and Grounds, respectively. As already noted, the distribution of the vegetable, flower, cotton, tobacco, and lawn-grass seed was made under a contract with the New York Market Gardeners' Association. Owing to various circumstances, the work carried on under this contract was not entirely satisfactory, and for this reason a full settlement has not as yet been effected. When matters now pending are definitely settled a full and complete report will be made on the entire work.

PLANS FOR THE FORTHCOMING DISTRIBUTION.

Owing to the fact that the contract for the fiscal year ended June 30, 1902, had been awarded when the seed work was turned over to the Bureau of Plant Industry, it was impracticable to make a number of important and necessary changes in the work. Some modifications have been brought about, however, and it is believed that these will lead to improvement in a number of directions.

The contractor this year is The Henry Phillips Seed and Implement Company, of Toledo, Ohio, who will put up and send out the vegetable and flower seeds only. All other seeds and plants will be handled by the Department, as it is believed better results can be obtained in this way. In connection with the work done by the Department, the distribution of seeds of grasses and forage plants will receive special attention. Aside from the usual distribution of lawn-grass seed to Senators, Members, and Delegates in Congress, it is planned to send out, on Congressional orders, five or six special forage crops which are comparatively new and which give promise of being of value for certain regions. In order to best effect the distribution of this seed the country will be divided into several districts, and a particular forage crop sent where it is likely to prove most valuable.

Another innovation will be made in the matter of distributing cotton seed. Instead of the usual practice of sending out small packages of seed of common forms already well known, an effort will be made to secure for distribution promising new sorts adapted to special regions of the South. For several years the Department has been engaged upon an investigation of cotton with a view to securing varieties better adapted to certain regions and more resistant to diseases. Already excellent results have been obtained in this work, and it is planned to eventually distribute seeds of the new sorts in order to give them widespread dissemination. The cotton seed this year will be sent out in larger quantities than before, for the reason that better results will be obtained by encouraging the planting of sufficient seed to determine its value. Already definite arrangements have been made for securing most of the seed, and it is believed much benefit will result by its distribution.

In the distribution of tobacco seed arrangements have been made to cooperate with the Bureau of Soils. It is planned to send into each district only the varieties likely to succeed there. In order to secure only the best seed for this purpose arrangements have been made for a special selection of the seed, and each Senator and Member living where tobacco is grown will have placed at his disposal a sufficient number of packages of selected seed to give the varieties a thorough trial.

Under the direction of the Secretary, arrangements have been made to send out this year, for the first time, a number of choice young trees, the object being to encourage a love for trees and all that the planting and care of them involves. No attempt will be made to send out large numbers of any one kind, but it is believed that the distribution of a few of the little-known sorts, particularly the rarer nut trees, will be of much value, especially if the trees themselves are accompanied with instructions as to their planting and care.

Aside from the special matters noted above every arrangement has been made to secure seeds of high quality, and to have every variety properly packeted, labeled, and sent out promptly.

SPECIAL RECOMMENDATIONS.

In addition to the recommendations and suggestions already given under the reports of the executive officers, special attention is called to the necessity of pushing vigorously a number of important lines. In the work carried on by the office of the Pathologist and Physiologist, important studies should be taken up of various fungi and bacteria which affect either detrimentally or beneficially the flavor, odor, wholesomeness, and market value of various agricultural products. It is now largely an accident whether many of these products are good or bad, as it depends largely upon what organism or ferment happens to gain the ascendancy during the particular stages of manufacture. If the question were reduced to the basis of exact knowledge, it would be possible to make American products that could compete in quality and price with the very best to be had anywhere in the world. Requests have been received from flax growers for pure cultures and information concerning the organism which brings about the retting of flax. In this country, at least, the retting of flax is a mere hit and miss business, and the product may be good, indifferent, or worthless; but if the manufacturer could start with pure culture inoculations of a given organism serious losses would be avoided and a uniform and high-grade product obtained. Studies of the fermentation processes which go on in the silo should be taken up, as well as those which have to do with bread making and the softening of pickles, olives, etc.

Another line of important work which will require special attention is a study of the diseases of forest trees and construction timber. Attention has already been called to the importance of this work, but to enlarge and push it as requirements demand will necessitate additional funds.

In the botanical investigations and experiments it is highly necessary to push as rapidly as possible the important work in the methods of sowing clover and other field seeds, in order to secure a standard under various conditions of soil or climate. The work on the methods of treating and preserving seeds should also be pushed without delay. Problems along these lines arise with special urgency in respect to the seed of cereals, sorghum, soy beans, and vetches. Considerable work must be done before we are in a position to explain the cause of the deterioration of seeds and to suggest preventive measures. It is also highly important to extend as rapidly as the means can be secured investigations on tropical crops. Already the Department is receiving many inquiries as to the best crops for our tropical possessions, and special funds will be required to extend the work so as to answer these inquiries. The important work inaugurated last year in this office on the study of the loss of grain in export shipments also needs funds for rapid extension. To carry on these and other important lines of work in the office of the Botanist, increased appropriations have been estimated for.

Some of the most important problems having to do with agriculture and agricultural development in this country are those pertaining to the grass and forage-plant investigations. The Agrostologist is making a strong effort to push this work as rapidly as funds will permit. To broaden the investigations in a way commensurate with their importance will require additional funds, and it is urgently recommended that these be allowed. Of the special work in this connection, it may be said that it is highly important that a thorough investigation be

made of the forage plants and forage conditions in the West at different seasons of the year, and particularly in the autumn, when the range is at its best and the opportunity is excellent for collecting and studying the grasses and forage plants. Too much attention can not be paid to the native grasses which are already adapted to unfavorable conditions of ordinary vegetation. The work that has been done at Abilene, Tex., and the work that is now being carried on at Tucson, Ariz., gives assurance of remarkable possibilities in the restoration or improvement of the great cattle ranges and pastures of the West by judicious management and reseedling.

One familiar with the well-grassed meadows and hillsides of the Eastern and Middle States can form little idea of the utter desolation and barrenness of hundreds of thousands of square miles of territory in the West that formerly supported untold numbers of fat cattle. This condition has come about through overstocking the ranges and mismanagement of the land. The experiments already made lead us to believe that these now desolated areas may be restored to their former productiveness. Our knowledge of the habits and capabilities of our native grasses and forage plants makes this assurance doubly sure, for in them we will find the means of again covering the ground with nutritious herbage. If the land is again regressed the precipitated moisture will be preserved and prevented from running off in torrents and carrying with it the best plant food in the soil. To us it appears that Government range reserves would have an importance fully equal to the forest reserves, about which there is no question, and if properly handled might play even a greater part in the conservation of the precious moisture of the semiarid regions. It is a work which affects the entire live-stock interests of the country, and its demonstration in such States or Territories as may be selected for the purpose will enhance the value of the range lands of the entire West.

In the pomological investigations very encouraging results have already been obtained in the important new work inaugurated in the matter of extending our fruit markets. It is believed that a promising field is open for the fruit growers of this country if certain important principles can be worked out and understood, especially those pertaining to the best means of handling, storing, and shipping the fruits. The markets of Europe are open to us, and there is no reason why we should not greatly extend our market possibilities by taking advantage of the demand for good fruits abroad. To accomplish this, however, will need careful investigations in order to enable our fruit growers to know definitely the best means to adopt in order to get their product across the water in good condition. These are some of the new problems being pushed in the pomological work, and for the extension of which additional funds are required.

REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., July 24, 1901.

SIR: I beg to submit herewith a statement of the work carried on in the Division of Chemistry for the fiscal year ended June 30, 1901, with plan of work in the Bureau of Chemistry for 1902 and proposed work for 1903.

Respectfully,

H. W. WILEY,
Chemist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

NEW WORK.

The most important new work during the year was the establishment of a laboratory for the investigation of the physical and chemical properties of the materials used in building roads. This work has both a high scientific and practical value in the construction of good roads.

It is a well-known fact that the agricultural value of farm products depends largely upon the accessibility to markets. Accessibility to a market is not judged alone by distance in miles from the place where the crop is grown; it is judged rather by the facilities and cheapness of transportation. New York City is a market which is reasonably accessible to the West India Islands, on account of the cheapness of transportation by water. It is, however, judged from a market point of view, at a great distance from many places in New York State, in the Adirondacks for instance. Farms which lie within a few miles of a market are often so difficult to reach as to render it almost impossible to realize any profit on the products of their fields. The building of good roads is, therefore, directly related to the progress of agriculture.

It is perfectly evident that many millions of dollars have been wasted in the building of roads because the nature of the material used for surfacing has not been known. The surface of a road must be hard enough to resist the ordinary wear and tear of traffic, and should be composed of materials which, when reduced to powder, have a certain cementing value which prevents the comminuted particles from being removed by wind and water. The character of the materials used in a road must also be adapted to the kind of traffic to which the road is to be subjected. A roadway constructed for the light carriage traffic of a city and its suburbs should be composed of quite different materials, placed in a different manner, from a road over which heavily loaded wagons are to be drawn.

All these problems connected with the nature of road materials are of a physical and chemical nature. It is true they can all be worked out by actual experience, but experience in this case is extremely costly. The most certain and economic way of solving these problems is in the laboratory. There small quantities of material can be subjected to all the tests of stress, friction, and cementation to which they would be subjected if actually placed in a road for use. Thus, with only a very small quantity of material, had at a comparatively low cost, the actual value of the material can be ascertained with a high degree of accuracy.

For the purpose of studying these problems, a laboratory, as has been stated, was established in the basement of the chemical building, in which a large part of the machinery necessary to the testing of road materials has already been installed. No chemical work in connection with the structure of road materials, in relation to their surfacing and cementing properties, was undertaken during the year, by reason of a lack of chemical force. Full preparation, however, was made for the beginning of this interesting part of the investigations during the present fiscal year.

INVESTIGATION OF THE INFLUENCE OF ENVIRONMENT ON THE SUGAR CONTENT OF THE BEET.

Since the beginning of the investigation of the chemical composition of sugar-producing plants by the Division of Chemistry, now more than a quarter of a century ago, the great influence of environment, that is, soil and climatic conditions, upon the sugar content of the beet has been recognized. By reason of the extreme variation in environment of this nature in different parts of the United States, it is evident that this influence is more pronounced in the case of the beets grown in this country than in those grown in Europe. In a general way, for the last fifteen years the Division had been able to point out with a reasonable degree of accuracy the areas in the United States which, in the light of the investigations which had been conducted, were best suited to the growth of sugar beets with a maximum content of sugar. These widely extended investigations, covering a period of nearly thirty years, formed a substantial basis from which to begin in a more systematic way the practical study of the influence of environment.

The object in view was to determine, first of all, the exact force of environment, and, second, by analysis of the various factors of environment to determine those which were most active either in increasing or diminishing sugar content.

It is evident that in a study of this kind the Division must have recourse to the collaboration of other Bureaus and workers. In the present instance the Division was most fortunate in securing the active cooperation of the Weather Bureau in determining as nearly as possible the conditions of the weather during the periods of growth of the experimental fields. It was also fortunate in securing the active and hearty cooperation of a number of the agricultural experiment stations, which were selected with a view of securing as widely different conditions of environment as could be obtained. The stations cooperating in this work were those of Indiana, Iowa, Kentucky, Michigan, North Carolina, Utah, Virginia, Wisconsin, and the two stations in New York. The plan adopted for the work was as follows:

A high-grade beet seed of uniform character was distributed to each of the collaborating stations. Portions of the same lot of seed

were also planted at the experiment station of the Department on the island below Long Bridge, District of Columbia. Each collaborating station kept a complete field record of its operations, including the method of preparing the soil, time of planting, character of cultivation, and time of harvest. The observers of the Weather Bureau, at or near the points at which the experiments were made, kept a regular, full record of precipitation, temperature, and hours of sunshine. Analyses of the beets grown were made both at the collaborating stations and in this laboratory. Since the beets were all produced by seed of the same kind, grown in the same locality and of the same quality, and since the conditions, aside from environment, were practically the same in all cases, it is evident that any variation in the chemical composition of the beets produced must have been due to soil and seasonal influences.

The analytical data were tabulated, and from these data descriptive charts were drawn, three in number. In each of the three charts the content of sugar was taken as the basic line of illustration. The collaborating stations, together with the station at Washington, D. C., were arranged in the order of the sugar content. The first chart represents by platted curves the percentage of sugar in the beets, the latitude of the collaborating stations, the hours of sunshine in a percentage of the total possible sunshine, and the distribution of sunshine by months, that is, the number of clear days calculated on a scale of 30.

The second chart contains, platted in like manner, the sugar in the beets in percentage, the total rainfall on a scale of inches, the altitude, being the distance of the collaborating stations above the sea level in feet, and the distribution of rainfall by months, scale in inches.

The third chart contains the percentage of sugar in the beets, the coefficient of purity of the juice of the beets on a scale of 100, the temperature during the growing months, scale in degrees Fahrenheit, and the average length of the days, scale in hours and minutes.

These charts, with the accompanying text, are believed to present the first really systematic statement of the effects of environment upon the sugar beet which has ever been published in this country. This is said without casting any reflection whatever upon the previous publications of this Department on the same subject. It must not be forgotten, however, that the previous publications were merely incidental to the principal end which was kept in view, viz, the determination of the sugar content of the beet over wide areas of distribution. A bulletin containing the chemical data, descriptive text, and the graphic charts above mentioned will soon be published.

INFLUENCE OF ENVIRONMENT ON THE GLUTEN CONTENT OF WHEAT.

Under authority of Congress, the investigation of the influence of environment on the gluten content of wheat was conducted through the collaboration of experiment stations in different parts of the country. The stations engaged in the work were those of California, Colorado, Indiana, Kentucky, Maryland, Michigan, and Missouri. The wheat which was sown at these various stations was all of the same kind. The chemical composition of this wheat was carefully determined before the distribution of the seed. Samples of the wheat grown in the different stations were sent on for analysis and the analytical data were obtained in the same manner as in the original

sample. The results were of the most surprising nature, showing that even in the course of a year the influence of environment was so great as to cause a variation from the original content of gluten of 50 per cent or more. In most instances the content of gluten was less than in the original seed. In one or two cases it was greater.

In addition to the study of the gluten content, as has been mentioned, a complete analysis of the wheat was made; sections were also made for microscopical examination for the purpose of showing any alteration in the character of the grain itself. When the extent of these variations has been carefully determined and the causes which produce the variations ascertained, in so far as possible, valuable practical deductions can be drawn which will help scientific farmers to a certain extent to control the content of gluten as well as of other valuable materials in the crop. Since for bread making and macaroni making the content of gluten is of the utmost importance, it is evident that the value of a wheat in the market can be greatly increased if some practical method of maintaining and increasing the gluten content can be devised.

INVESTIGATION OF INSECTICIDES.

In collaboration with the Division of Entomology, the determination of the chemical constituents of the insecticides sold throughout the United States was continued and completed, in so far as we are able to secure the samples. It is believed that we have secured, through the collaboration of the Division of Entomology, a sample of every insecticide which is made in any quantity in the United States. Some remarkable facts have been brought out in this investigation. The most important to the farmer, from the practical point of view, is that many of the so-called insecticides contain only a mere trace, or none at all, of insect-killing drugs or poisons. In many others where poisonous principles were present we found them so diluted and adulterated with inert materials as to greatly lessen their value for the purpose for which they were sold, without correspondingly diminishing their price to the consumer. It is not right that a farmer should risk his potatoes, tobacco, or other crops subject to insect ravages by reason of the worthless character of the insecticide which he purchases. While there is no National law regulating the subject, it is believed that an investigation of this kind will awaken the interest of farmers throughout the country to the necessity of at least enacting State laws for their local protection, eventually leading to a National law which will make the State laws more effective and the protection to the farmer more certain.

It is, of course, evident that the only object of adding inert substances to insecticides is to increase weight without correspondingly diminishing the selling price. There can be no objection to the diluting of a powerful insecticide with some inert substance for the purpose of rendering its action less vigorous, and thus preventing its injuring the crop. In such a case, however, every package of insecticide as sold should bear a plainly printed label on which the character of the diluent and the amount thereof employed are distinctly set forth. The purchaser, then, would not be the victim of a fraud, and if he should not care to purchase a cheapened article, thus described, he could simply invest in other and more powerful remedial agents.

The results of this investigation have been prepared for publication in two forms: One, a Farmers' Bulletin, in which some of the general principles relating to the composition of insecticides are set forth,

with illustrations of adulteration given by numerous citations from the work done in the Division; the other giving in more technical form full details of the work, describing the methods employed and the analytical data obtained and soon to be submitted as one of the technical publications of this Bureau.

SOIL STUDIES.

The studies of soils, in relation to their composition as affecting plant growth and the nature and character of the microorganisms which they contain, authorized by Congress, have been pushed steadily forward. The magnitude of this work has been described in previous reports. It is only proper to add, however, a brief statement of what was done during the year.

After five years of experimentation, the soils were thoroughly sterilized so as to destroy adventitious ferments, and the proper ferments were added to the sterilized soils by seeding the pots with some solution of soil taken from a very fertile spot. The pots were thus prepared for a new series of determinations which it is proposed to carry forward during the coming five years.

The data of the first five years have now been collected and are ready for publication in the following particulars:

(1) The chemical composition of the soils, as determined by all the standard methods.

(2) The available plant food in the soils as determined, first, by all the ordinary chemical methods; and, second, by the quantities of plant food removed from the soil during a period of five years, with two crops each year, making a total of ten crops.

(3) The relation of available fertility in the soil to the production of crops, studied by a new method devised in the Division, whereby the soil is subjected to the solvent action of a very weak solution of hydrochloric acid, at a temperature of 40°, for a definite period of time.

This late method of treatment has been more successful in establishing the relation between the availability of plant food in the soil, as determined by chemical analysis, and the actual crop produced than any other method now in vogue. The data obtained in this way so far relate solely to the availability of the phosphoric acid and potash. For the purpose of including the nitrogen content of the soil in these investigations a new series has been commenced, in which all three of the elements mentioned, viz, phosphoric acid, potash, and nitrogen, will be taken into consideration in the discussion of the problem.

The importance of this investigation will only be fully appreciated when, in case the laboratory data are borne out by practice in the field, it can be shown that a full and speedy soil survey, from a chemical point of view, can be made of a field without the elaborate and time-consuming investigations which heretofore such studies have required.

COMPOSITION AND ADULTERATION OF FOODS.

During the year the chief part of the work done in this direction was in the investigation of preserved foods, preserved meats, especially canned meats of all kinds, and the delicatessen of animal origin kept in high-grade grocery stores. In order to have a solid scientific basis for these investigations, fresh meats were secured, their composition determined, and then the meats canned in the ordinary way. After a time the cans were opened and the meats they contained

subjected to chemical examination. By this method a direct comparison was secured between the great number of meat products examined and the original fresh products from which they were made. The amount of chemical work involved in this examination was of great magnitude, and the bulletin containing the data of this work will consequently be of a bulky nature. It is now ready for submittal.

An elaborate investigation was also made of the character of horse meat, with the object of determining whether or not it is sold surreptitiously in this country for beef and also to determine whether or not when mixed with other meats, as in the instance of making sausage, the parts derived from the horse could in any way be identified. The two obvious methods of procedure which would be naturally suggested in this case were followed, viz, (1) microscopic examination of the meat fibers and (2) determination of the chemical composition of the mixtures. To this end mixtures of horse meat with other meats in known proportions were made, converted into sausage, and afterwards given to the analysts without their knowledge of its contents for the purpose of determining whether or not horse meat was contained therein. The microscopic efforts in this line were futile, since it was not possible to discover with certainty the fibers due to horse meat in a mixture of that meat with certain other forms previously subjected to the vigorous action of the sausage grinder.

In the study of the chemical composition as a means of discriminating between horse meat and other kinds of flesh, more favorable results were obtained. The meat of the horse contains quite a large quantity of a sugar-producing substance known as glycogen. Other common edible meats, with the exception of the meat of the lobster, crab, and crayfish, contain only small quantities of this substance. It is evident, therefore, that a determination of glycogen in a mixture would be a valuable indication in regard to the origin of the meats therein in so far as the horse is concerned. When the elucidation of this problem was begun, however, it was discovered that none of the accepted standards of examination was satisfactory. It was, therefore, first of all necessary to develop, by modification and otherwise, a method of determining glycogen in horse meat which was reasonably accurate. This, happily, was accomplished, and we were then able to detect the presence of horse meat in a mixture, provided the amount thereof was not reduced to too low a percentage. Working with the greatest care, it is believed that as little as 10 per cent of horseflesh with beef can be detected with certainty by the methods used in this laboratory and described in full in the forthcoming bulletin above referred to.

Not only is it possible to use the glycogen content for the purpose of detecting a mixture of horse meat in sausages, but the iodine number of the fat is also valuable. The iodine absorption of the fat of horse meat is very distinctly higher than that of beef, when both are determined in the fresh state, and this is an additional evidence on which a discrimination between the two can be based.

In the case of smoked meats, however, this number is not so valuable, since it has been found that in the fat of beef after smoking, the iodine number is markedly higher than it was before.

INVESTIGATION OF IMPORTED FOODS.

Under renewed authority from Congress, the work of the investigation of the character of imported foods was carried on during

the year, and the reports of these investigations have been confidentially submitted to the Secretary of Agriculture. The value of the data which have been obtained in this way, however, is so great as to warrant the belief that their publication would be advisable. The scope of this investigation has been very broad, including wines and beers, dairy products, especially cheeses, salad oils, delicatessen of all kinds, preserved fruits, jellies, jams and marmalades, and, in fact, nearly every article of food imported. These data would be so valuable to the food chemists of this country and to food experts in general, if published, that I am led to recommend their collection into a form proper for publication as a bulletin of the Bureau of Chemistry.

INVESTIGATION OF FOODS INTENDED FOR EXPORT.

Congress has authorized the Secretary of Agriculture, through the Division of Chemistry, to inspect food products intended for export to foreign countries where chemical and physical tests are required of foods offered for sale. Unfortunately, Congress gave no appropriation for carrying this work into effect, and therefore it has not been possible to institute the control contemplated by the act. Full preparation, however, has been made for the inception and prosecution of this work whenever the funds are forthcoming, and as a preliminary step a careful study of the foreign laws regulating the sale of foods has been made. The results of this investigation were published as Bulletin No. 61 of the Division of Chemistry. Exporters of foods interested in knowing to what tests their exports will be subjected in foreign countries can ascertain them by applying to the Secretary of Agriculture for a copy of the bulletin mentioned.

CHEMICAL COMPOSITION OF WINES, CIDERS, AND OTHER FERMENTED BEVERAGES.

Work has been continued during the year, in collaboration with the viticultural associations of the country, in a study of the composition of American wines. This work was particularly opportune in consequence of the exhibition of a large number of standard American wines at the World's Fair in Paris. Not only were our own wine makers gratified, but the wine growers of Europe were somewhat astonished at the fine showing made by our wines in Paris. More than 90 per cent of all the samples exhibited received awards. When it is remembered that only about 40 per cent of the objects exhibited received recognition, this high number for our own wines is extremely flattering. Among the awards was a large percentage of gold and silver medals, and, in one instance, an American wine was marked the highest possible number below that which would have entitled it to the grand prize, viz, 18 on a scale of 20. Had it not been that the particular wine in question bore as parts of its label names indicative of foreign origin it is probable that it would have received the grand prize.

Not only the American still wines, but, what is more surprising, the American sparkling wines received very high awards. When it is borne in mind that the jury was composed almost exclusively of foreigners, having only two American representatives, and that there was a certain trade prejudice against American wines, this high rating becomes the more noteworthy.

In connection with this study a special agent of the Department was

commissioned to go into the wine districts of southern France for the purpose of studying particularly the methods of vinification employed and to ascertain whether or not any adulterations were practiced. A valuable report of the observations of this special agent is almost ready for publication.

Another special agent of the Department was commissioned to study the methods employed in cider making in England, France, and Germany, with special reference to the influence of the different ferments upon the chemical composition of the product. Large numbers of samples of these ciders have been analyzed in the Division in Washington, and a report of the special agent, together with a report of the chemical study, will soon be ready for publication.

The practical information in these reports will be of the greatest value to the wine and cider makers of our country in helping them to secure a product from the ripened fruits of a high grade and a greater market value than heretofore. In this way the chemical studies supplement the practical work of the orchardist and viticulturist by taking their product after the ripening of the fruit and showing in what way the best composition of the wines and ciders can be secured.

COLLABORATIVE WORK WITH DIVISIONS OF THIS DEPARTMENT.

In addition to the collaborative work mentioned above, the Division conducted extensive investigations during the year in dairy products for the Bureau of Animal Industry. For the Division of Vegetable Physiology and Pathology an extensive series of analyses of wheats used for the manufacture of flour employed in making macaroni was undertaken and completed. This work was supplemented with a chemical study of the macaronis themselves. All the data of these cereal investigations have been transmitted to the Bureau of Plant Industry, and I believe will soon be published.

COLLABORATIVE WORK WITH OTHER EXECUTIVE DEPARTMENTS.

The collaborative work with other Executive Departments of the Government continued during the year.

TREASURY DEPARTMENT.

In order to make the collaborative work more useful to the Treasury, the chief of the Division of Chemistry was, with the consent of the Secretary of Agriculture, appointed during the year by the Secretary of the Treasury as supervisor of sugar tests for the appraisers' laboratories at Philadelphia, New York, and Boston. In connection with this work a systematic check test of exchange samples of sugar was carried on in the laboratory of the Division during the year. The manual and clerical labor necessary to this work would be justly charged to the account of the Treasury, but so far it has been given by the Department of Agriculture without expense to the Treasury.

This work is of the greatest importance on account of the fact that the levying of duties on imported sugars is determined wholly, with the exception of high-grade white sugars, by the polariscopic test. The importance of having this correct and uniform is, therefore, at once apparent. The results obtained in the laboratory of the Division, with those secured in the various laboratories of the appraisers above mentioned, are compared monthly, and if any notable discrepancy is

discovered attempts are at once made to ascertain the cause of such discrepancy and to devise means for obviating it. The result of this collaborative work is that the various chemists in the appraisers' laboratories are working more and more upon a uniform plan and securing by far more uniform classifications than have ever heretofore been obtained.

WAR AND NAVY DEPARTMENTS.

During the year large numbers of samples of foods and supplies for the Army and Navy have been examined in the Division of Chemistry upon request addressed to the Secretary of Agriculture. Most of these examinations have been for food supplies, but many of them have been for clothing and other things necessary to the Army and Navy at home and in the Tropics.

It seems desirable that there should be some central laboratory of this kind where the various Departments of the Government can secure chemical services, and the equipment and scope of the work of the Bureau of Chemistry seems to indicate that it is here that such work will be principally done. This is the more probable on account of the hearty sympathy of the Secretary of Agriculture with the other Departments in their efforts to secure a proper chemical control of the foods and supplies which are demanded for the public service.

POST-OFFICE DEPARTMENT.

A number of investigations was made during the year for the Post-Office Department with reference to the composition of articles which it was desired to have forwarded through the mails and in the study of problems submitted by the Postmaster-General relating to the needs of his service. Among these may be mentioned the examination of inks, used not only in the service of the Post-Office Department, but by the Department of State and many other Departments of the Government. It is important that these inks should be plain, legible, and, so far as possible, indelible. Large numbers of such inks have been submitted to us by the Post-Office and State Departments. Their composition has been studied, the character of the imprints they made ascertained, and reports made in regard to comparative efficiency to the various Departments requiring our aid.

INTERIOR DEPARTMENT.

The Division of Chemistry continued its cooperation with the Interior Department in regard to the study of the composition of all the important springs on the Government reservation at Hot Springs, Ark. This work employed one of the chemists of the Division for the greater part of the fiscal year, and the salary and traveling expenses of this chemist were paid by the Department of the Interior. The general details of the results of the investigation have been reported from time to time through the Secretary of Agriculture, and it is believed that a full report on this investigation will be ready to go forward not later than the first of November.

COLLABORATIVE WORK WITH THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The cooperative work with the Association of Official Agricultural Chemists has been prosecuted during the year as usual. All the

referees of the association sent samples to the Division for comparative determinations.

The annual meeting of the association was held, as usual, under the patronage of the Secretary of Agriculture. The proceedings of this meeting were published as Bulletin No. 62 of the Division of Chemistry.

PLAN OF WORK FOR THE FISCAL YEAR ENDING JUNE 30, 1902.

By act of Congress, the Division of Chemistry, on the 1st of July, 1901, became a Bureau. This change in name and status of the Division, however, did not in any way interrupt the character of the work already undertaken. It did, however, open the way to a much broader field of work in the way of collaborating with the various Divisions and Bureaus of the Department and with the other Departments of the Government.

SOIL WORK.

The investigation of soils, with relation to determining their chemical constituents available as plant food, will be continued in the line of work described in the first part of this report.

COMPOSITION AND ADULTERATION OF FOODS.

During the fiscal year this work will be directed chiefly to a study of infants and invalids' foods and to the adulteration of salad oils. It has been a matter of comment that alleged pure olive oils are imported into this country and sold at a price below the market value of the pure olive oils of California. The object of the study will be to determine whether or not the imported so-called olive oils are really pure.

In the case of infants and invalids' foods, an attempt will be made to study all the leading brands upon the market for the purpose of ascertaining, first, in the case of infants' foods, whether their composition resembles that of the natural food of the infant, and, second, in the case of invalids' foods, whether they contain the proper nourishment and in the proper form for the sustenance of invalids whose digestive organs are usually far below the normal standard.

INVESTIGATION OF SUGAR-PRODUCING PLANTS.

This work will be continued during the present fiscal year on the lines already referred to. The collaboration of the experiment stations in studying the effect of environment on the composition of the beet will be continued. Miscellaneous analyses of samples sent in by farmers throughout the country will be made. An experimental plot planted to several varieties of beets is growing at the Department's station on the island below Long Bridge, District of Columbia. A complete series of studies of this plot will be conducted.

Arrangements have been made with Capt. D. G. Purse, president of the Board of Trade of Savannah, for a systematic examination of the soils in southern Georgia and Florida on which sugar cane is grown for the manufacture of molasses, sirups, and sugars. Samples of these canes will also be forwarded for analysis during the harvesting season.

The presence of sugar in the muskmelon or cantaloupe is one of the

most desirable properties for table consumption. The excellence of these melons is usually judged by their sweetness. An extensive comparative study of melons has been arranged for in cooperation with a number of experiment stations. The melons are all grown from the same variety of seed, and in so far as possible the cultivation has been the same. The difference in composition will therefore show the influence of environment upon the sugar content of this highly prized product.

CHEMICAL COMPOSITION OF WHEAT.

The collaboration of a number of experiment stations in determining the influence of environment upon the chemical composition of wheat will be continued for the present year. In connection with these studies, a complete system of milling has been arranged for whereby the flour-producing properties of the cereals can be determined in connection with their chemical composition. It is proposed to supplement this grinding with baking tests to determine the qualities of the flour for bread making.

The properties of other cereals in respect of their technical uses is another branch of chemical investigation which will be undertaken during the year. This is particularly true of barley used for the preparation of malt and the development of the diastatic ferment for converting starch into sugar.

EFFECTS OF COLD STORAGE ON THE CHEMICAL COMPOSITION OF FOODS.

In conjunction with the National Warehouse Association an investigation of the effects of cold storage on the composition and nutritive value of foods will be undertaken. The association will bear the expense of the storage and transmission of the samples. The line of work marked out is, first, the determination of the composition and nutritive value of the foods when placed in storage, and, second, the withdrawal of certain portions of the whole amount, from time to time, for a similar examination. The length of time for the whole study will be that of the usual time of storage.

CHEMICAL COMPOSITION OF WINES, CIDERS, ETC.

In conjunction with the viticultural associations of the country, and in collaboration with the agricultural experiment station at Blacksburg, Va., extensive analyses of wines and eiders will be made. The object of these analyses is to determine the chemical composition of wines and ciders, with reference to the effect which different processes of vinification and fermentation have upon the chemical properties. The importance of this investigation to our fruit-growing interests is evident. A work of this kind will supplement in a practical way the work of the orchardist and viticulturist by showing the best methods of securing a higher grade product for the market after the fruits have been grown.

DENDRO-CHEMICAL INVESTIGATIONS.

Extensive investigations of the chemical composition of forest products of the country will be undertaken in collaboration with the Bureau of Forestry. The first work of this kind will be the study of the tannin products in the different varieties of tannin-bearing trees. There has

never been a systematic study of the chemistry of our forest products, and this work promises much of interest and benefit in this direction.

DAIRY CHEMISTRY.

In collaboration with the Bureau of Animal Industry, the study of dairy products will be continued. Many problems of great importance await investigation, and work will be done in this line in so far as the routine analyses of dairy products will permit.

REVISION OF BULLETIN NO. 13.

The early editions of the parts of Bulletin No. 13, on food adulteration, are out of print. Work has already been commenced toward the revision of these parts, for which such an unusual demand has been made. A large amount of material for the rewriting of Part I, on dairy products, has already accumulated. Work has already been commenced for the rewriting of the part devoted to tea, coffee, and chocolate. Other parts of the bulletin will be revised and brought up to date as soon as possible.

INSECTICIDES.

The study of insecticides, in collaboration with the Division of Entomology, will be continued for the purpose of making a complete study of the chemical composition of all the insecticides sold in the United States. This work will be devoted to the study of the composition of new forms of insecticides as they are brought upon the market.

COLLABORATION WITH THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

This very important part of our work will be continued during the year in all branches of investigation. The Secretary of Agriculture has made the referees of the association special correspondents of the Department, whereby they are privileged to use the frank of the Department in correspondence relating to their work and in transmitting samples for comparative study. There is probably no branch of the work of the Division, now Bureau, of Chemistry which has been of such direct practical benefit to the farming interests as the work of this association. The existence of the association has been made possible only through the patronage of the Department, which has made its work a part of the studies of the Division, and enabled the results of its proceedings to be placed in a suitable form in the hands of agricultural analysts throughout the country. This work has been fully appreciated, not only in this country, but also in Europe, and the official methods adopted by the association are now accepted throughout the world as standard methods of analysis.

INVESTIGATION OF ROAD MATERIALS.

The laboratory for the investigation of road materials will be more fully equipped during the year, and, in collaboration with the Office of Public Road Inquiries, an extensive investigation will be made of the physical and chemical properties of the materials used for road building.

COLLABORATION WITH OTHER DEPARTMENTS OF THE GOVERNMENT.

The work of supervision of the sugar laboratories of the appraisers of customs in Philadelphia, New York, and Boston will continue to be directed by the Chief of the Bureau of Chemistry under the agreement between the Secretary of Agriculture and the Secretary of the Treasury.

The examination of foods and other supplies for the commissary department of the War and Navy will be continued.

The work in water analysis for the Interior Department will be completed about November 1, 1901.

The examination of miscellaneous articles, of inks, substances supposed to be unmailable, etc., for the State, Post-Office, and other Departments will be continued.

PROPOSED WORK FOR THE FISCAL YEAR ENDING JUNE 30, 1903.

The proposed work for the year ending June 30, 1903, will be a development and extension of the lines of work already pointed out. An effort will be made to complete the organization of the Bureau of Chemistry so as to segregate, so far as possible, the different lines of investigation. It is evident, however, that all forms of chemical work are interlocked in such a way that a complete segregation is not desirable nor possible. The principal lines of work for the Bureau of Chemistry, as planned up to the end of the fiscal year June 30, 1903, are as follows:

FOOD STUDIES.

The study of the composition, adulteration, and nutritive properties of foods will be devoted particularly to a revision of Bulletin No. 13. The object of this work will be to extend the investigations to bring the work up to date and to coordinate in a better manner than was possible in the first series of investigations the different parts of the work. The food laboratories will afford one of the principal fields of investigation for the Bureau.

Congress has authorized the Secretary of Agriculture, through the Bureau of Chemistry, to analyze and certify to the character of exported food products sent to countries where physical and chemical tests are required in commerce in foods. There is, perhaps, no part of the work of the Bureau which would be of more practical advantage in enlarging our foreign markets than this. Unfortunately, no funds were appropriated to carry out the provisions of the act of Congress, and therefore a special appropriation is recommended in the estimates for the purpose mentioned. If Congress will give the required funds, we will be able to send our food products abroad with a certificate of character which will not permit them to be lightly dealt with by officials of foreign countries interested in excluding them from their markets.

STUDY OF PLANT FOODS.

The investigation of soils, in regard to the available plant food which they contain, and fertilizers will be continued and extended in collaboration with the Association of Official Agricultural Chemists. It is believed that the investigations which have already been completed have opened a new field of study which is full of promise for practical agriculture.

THE COMPOSITION OF SUGAR-PRODUCING PLANTS.

The increasing interest in this country in the sugar industry renders it advisable to continue, somewhat more systematically, the investigations which the Division of Chemistry has conducted during the past quarter of a century on sugar-producing plants. The appropriation to be asked for will include the study of all sugar-producing plants, viz, sorghum, sugar cane, and the sugar beet. The consumption of sugar is rapidly increasing, and, even with the aid of our insular possessions, we are still very far from supplying our own consumption. There is, perhaps, no other one industry, the development of which means so much to our agricultural interests, as that of our domestic sugar supply. This can only be accomplished in conjunction with careful chemical studies of the plants themselves, the changes which they suffer by environment, and the foods which supply their growth. It is hoped that this branch of investigation in the Bureau may include the following points:

(1) The collection of statistics relative to the sugar industry of the United States and its possessions.

(2) Investigations and collection of data concerning the adaptability of various parts of the United States to beet and sugar-cane production.

(3) Collection of technical data relative to the foreign sugar industry, for the purpose of keeping domestic producers advised of new methods in manufacture, etc.

(4) Publication, at regular intervals, of circulars including abstracts of descriptions of new methods, processes, machinery, and of investigations appearing in foreign sugar journals.

DENDRO-CHEMISTRY.

The progress of the Bureau of Chemistry will be, perhaps, more pronounced in the direction of dendro-chemistry than in any other one line of investigation. It is proposed to undertake, in collaboration with the Bureau of Forestry, investigations of the constitution of trees, products of distillation of wood, manufacture of wood alcohol, wood tar, acetone, and other products of the destructive distillation of wood; investigation of tanning materials, manufacture of tanning extracts, studies of distribution of resins and gums in wood, investigations of the use of wood pulp for paper making, the manufacture of cellulose, studies of the methods of preserving wood, and other chemical and techno-chemical processes relating to forest products.

CHEMISTRY OF DAIRY PRODUCTS.

The investigation of the chemical composition of dairy products will be continued, in collaboration with the Bureau of Animal Industry, and all proposed methods which have any promise of merit will be investigated. By act of Congress, the exporters of food products which are subjected to chemical and physical tests in foreign countries have a right to demand in the Bureau of Chemistry an analysis and certificate of the character of their goods before shipment. This work, when funds are provided for it, will be a prominent feature of the investigation. There are many other chemical questions connected with the composition of foods fed to dairy cows, and the effects pro-

duced on the chemical composition of butter, which demand further investigation.

INVESTIGATION OF MATERIALS USED IN ROAD CONSTRUCTION.

It is hoped that the investigations conducted in the Bureau of Chemistry in this important line may take first rank among similar investigations in different parts of the world. To this end this laboratory should be enlarged and more fully equipped and its working force increased. It is only in this way that the best results can be obtained and applied in the most practical manner.

COLLABORATIVE WORK WITH OTHER DIVISIONS AND BUREAUS AND WITH OTHER DEPARTMENTS OF THE GOVERNMENT.

This feature of the work of the Bureau of Chemistry becomes more important each year. Definite arrangements for collaboration are now in force and will, without doubt, be continued for the fiscal year ending June 30, 1903, with the Bureau of Forestry, with the Office of Public Road Inquiries, and with the Division of Entomology. A less definite system of collaboration is also established with the Bureau of Animal Industry and with the Bureau of Plant Industry. It is hoped that all these methods and systems of collaboration will assume definite form so as to secure the highest results more economically. For this purpose, I believe it is the unanimous opinion of all those interested in this collaboration that the appropriations for this work should be made directly to the Bureau of Chemistry instead of to the collaborating Divisions and Bureaus, and then assigned to the Bureau of Chemistry.

The collaboration with other Departments of the Government will undoubtedly also be continued and enlarged, as the tendency to the growth of this collaboration has been very great within the past two or three years. Since this collaboration has employed during the past year the time of at least two assistants in the Division, it is evident that a special appropriation should be made covering it. The Departments of the Government interested in this matter will thus be directly benefited and the organic relation of the Bureau of Chemistry of the Department of Agriculture to the general chemical work of the Government be strengthened.

CLERICAL SERVICES.

The expansion of the Division of Chemistry into a bureau, enlarging its work and perfecting its affiliations with other Divisions and Bureaus, and with other Departments of the Government, render necessary a considerable increase of the clerical force. The work of the Bureau of Chemistry peculiarly demands extra clerical services on account of the large amount of computation and tabulation which it requires, as well as the extensive correspondence involved. Through the courtesy of the Division of Statistics we have had a great deal of help in this line during the past year or two, but it is hardly fair to expect this help to be continued when it should be provided for in the Bureau itself. The organization of two new laboratories and the completion of the equipment of three others, making five in all, also involve a considerable extension of the clerical service. As in the

other Bureaus, the services of a chief clerk are necessary. A property clerk has also become a necessity. Perhaps there is no other Bureau, with the possible exception of the Weather Bureau, that has so valuable a collection of property as is found in the Bureau of Chemistry. The platinum ware alone in the possession of the Bureau is worth several thousand dollars. A great deal of the property of the Bureau is constantly passing into use and has to be replaced. The services of an additional stenographer and typewriter are necessary, besides additional assistants for the tabulating work before mentioned.

For the present, it is the purpose of the Bureau to retain the clerical force in a single body and not distribute it among the different laboratories. It is believed that a more economical and efficient use of the force can be secured in this way than in any other.

SALARIES OF HEADS OF LABORATORIES.

Under the present appropriation only one assistant in the Bureau of Chemistry receives a salary of \$2,500. The importance of the laboratory work in the Bureau, it seems to me, is quite as great as that in any other, and merits an equal compensation. It is not my purpose to ask for the whole of this increase at once, but only for a moderate amount. It is therefore recommended that the heads of the laboratories receive from \$2,000 to \$2,500 each.

WORDING OF THE APPROPRIATION BILL.

In order that the scope of the work outlined in the Bureau of Chemistry may be fully set forth before the committee of Congress having charge of the appropriations, a draft of the appropriation bill, in so far as it relates to the Bureau of Chemistry, is submitted. In this draft the estimated amounts for each branch of the work follow each section, but placed in brackets. It is desirable that the whole amount for the Bureau be appropriated in one sum, which is placed at the end, in order not to complicate the accounts of the Disbursing Office.

RECOMMENDATION REGARDING CHEMICAL WORK.

I strongly recommend that all the work of the Department of Agriculture of a chemical nature not otherwise specifically provided for by law be assigned to the Bureau of Chemistry, to be conducted in accordance with a plan to be mutually agreed upon by the chief of Bureau and the officials desiring the work done, and approved by the Secretary. The establishment of chemical laboratories is expensive, and the distribution of chemical work under various directions will lead to duplication, overlapping, and unnecessary expenditure. It is evident that the best and most economical work can be done under a single bureau, and doubtless Congress in establishing such a bureau intended it to have charge of all the chemical work of the Department. Among the investigations of this kind we may mention the study of the nutritive value of foods. These investigations are chiefly chemical, and would find in the Bureau of Chemistry an appropriate direction. The Bureau of Chemistry has sometimes been held responsible for chemical publications with which it had nothing whatever to do and to which its attention was never called until after the publication had been made. It is evident, if in the public mind work of this kind is attributed to the Bureau of Chemistry, that this is an

additional reason why this Bureau should have the supervision of the work and its preparation for publication.

CONCLUSION.

In closing this part of the report, I desire to call your attention to the fact that the Bureau of Chemistry is now organically connected not only with other Bureaus and Divisions of the Department of Agriculture, but with at least three of the great Departments of the Government. Its work is of the utmost practical importance to the farmer and to the public at large. It should receive generous support at the hands of Congress, and the estimates submitted are as modest as is consistent with the actual work which the Bureau will be called upon to do during the fiscal year ending June 30, 1903.

REPORT OF THE CHIEF OF THE DIVISION OF SOILS.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., August 25, 1901.

SIR: I have the honor to transmit herewith a report upon the work of the Division of Soils for the fiscal year ended June 30, 1901.

Respectfully,

MILTON WHITNEY,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

ORGANIZATION.

The organization of the Division has been essentially the same as heretofore. The principal lines of work have been confined to the administrative office, the laboratory of soil physics, the laboratory of soil chemistry, the soil survey of the Eastern division, the soil survey of the Western division, and the tobacco investigations. In the Bureau organization, which has been perfected, these lines of work are all maintained as divisions, and several other lines are under consideration, to be maintained as divisions, as will appear in my recommendations for the coming fiscal year.

The reorganization of this Division into a Bureau of Soils, with a large increase of funds and a corresponding enlargement of the opportunities for work, did not go into effect until July 1, 1901; but as \$10,000 had been made immediately available, it was possible to proceed at once with the gradual adoption of the plans which thus occupied fully six months of the fiscal year for which this report is intended. During this entire period the work went on without interruption, and indeed was facilitated and broadened in every way.

This reorganization of the Division was a substantial recognition of the value and importance of its work, as well as of the necessity for extending the soil survey and tobacco investigations to other States and of giving larger salaries to experts, in order to maintain the highest efficiency and to insure the most valuable results.

PROGRESS AND COST OF THE SOIL SURVEY.

The area surveyed and mapped during the fiscal year was 5,596 square miles, or 3,581,440 acres, and the area previously reported as having been surveyed was 3,486 square miles, making a total of 9,082 square miles, or 5,812,480 acres. Field work was carried on during the year in California, Maryland, Michigan, New York, North Carolina, Ohio, Pennsylvania, Utah, Virginia, and Washington; and preparations were all made for field work to be started in Idaho, New Jersey,

Tennessee, and Texas immediately upon the agricultural bill going into effect on the 1st of July, and also for field work in Louisiana, Mississippi, Georgia, and Florida, to be started on the 1st of October, when parties working in the Northern States will be sent South.

The following table gives the areas of soils surveyed and mapped in the several States in which the work has been carried on to the end of the fiscal year:

Areas surveyed and mapped during fiscal year ended June 30, 1901, and the areas previously reported.

State or Territory.	1901.	Previously reported.	Total.	
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Acres.</i>
Arizona	400	400	256,000	
California	951	450	1,401	896,640
Connecticut		245	245	156,800
*Idaho				
Louisiana		1,000	1,000	640,000
Maryland	1,137	625	1,762	1,127,680
Massachusetts		155	155	99,200
Michigan	35			
*New Jersey				
New Mexico		100	100	64,000
New York	30			
North Carolina	1,700	100	1,800	1,152,000
Ohio	480		480	307,200
Pennsylvania	320	100	420	268,800
*Tennessee				
*Texas				
Utah	457	311	768	491,520
Virginia	250		250	160,000
Washington	301		301	192,640
Total	5,596	3,486	9,082	5,812,480

NOTE.—Field work in Michigan and New York was started on June 15, but the areas surveyed in this fiscal year were too small to report upon the cost of the work, and they have not been included in the total. The preparations for the States marked with an asterisk (*) were all made in the fiscal year ended June 30, 1901, but the field work was actually started from the 1st to the 3d of July.

There is an increase of 2,200 square miles (or 60 per cent) surveyed over the preceding year, although the cost per square mile of the work in the field was just about the same. This increased area is due to the better training of the men and to the better organization of the work, enabling the parties to remain in the field for a longer time and reducing the cost of the preparation of the reports. The number of field parties and the personnel were the same, except that in the Statesville and Prince George areas the men were brought together on the 1st of April in order to train some new assistants.

The following table gives the details of the areas surveyed and the cost in each district in which work was carried on during the fiscal year:

Area surveyed and mapped, and cost of same, during fiscal year ended June 30, 1901.

District.	Area surveyed.	Cost.	
		Total.	Per square mile.
	<i>Sq. miles.</i>	<i>Dollars.</i>	<i>Dollars.</i>
Lancaster area, Pennsylvania	176	381	2.24
Lebanon area, Pennsylvania	150	291	1.94
Prince George County, Md.	460	1,569	3.41
Kent County, Md.	315	243	.77
Calvert County, Md.	218	416	1.91
St. Mary County, Md.	144	161	1.12

Area surveyed and mapped, and cost of same, etc.—Continued.

District.	Area surveyed.	Cost.	
		Total.	Per square mile.
	<i>Sq. miles.</i>	<i>Dollars.</i>	<i>Dollars.</i>
Bedford County, Va	250	468	1.87
Statesville area, North Carolina	800	1,824	2.28
Raleigh to Newbern, N. C	900	825	.90
Montgomery County, Ohio	480	571	1.19
Sevier Valley, Utah	150	643	4.29
Weber County, Utah	307	663	2.16
Fresno area, California	175	413	2.36
Orange County, Cal.	300	678	2.26
Hanford area, California	216	922	4.27
San Gabriel Valley, California	260	624	2.40
Yakima area, Washington	84	281	3.34
Sunnyside area, Washington	217	336	1.55
Totals and average	5,596	11,309	2.00

Area surveyed	acres..	3,581,440
Cost per 100 acres	cents..	32

RECAPITULATION.

Cost of field work	\$11,309.00
Supplies	434.30
Railroad transportation	1,730.18
Preparation of reports	6,247.85
Total cost of soil survey	19,721.33
Paid by State organizations	1,500.00
Paid by Department of Agriculture	18,221.33
Area surveyed	square miles.. 5,596
Cost of work in field	per square mile.. \$2.00
Preparation of reports	do .. 1.14
Transportation and supplies	do .. .39
Average cost	do .. 3.53
Average cost to Department of Agriculture	do .. 3.26
Average cost to Department of Agriculture	per 100 acres.. .51

Cost of field work includes salaries of all men for the time actually in the district, team hire, and subsistence, but not cost of transportation to and from the district.

Preparation of reports includes salaries of men during the winter when they are preparing their reports and not actually in the field.

It will be seen that the average cost of the work in the field this year was \$2 per square mile, or 32 cents per 100 acres, which is just about the same as reported last year. The expense varies considerably in different areas, according to the complexity of the work, the price of board and team hire, and the character of the topography and the roads of the district. The relatively high cost of the work in Prince George County, Md., and in the Statesville area was due to the fact, mentioned above, that quite a number of new men were assigned to these areas on the 1st of April for training, and this increased the expense of the work over what it would have been if done altogether by experienced men.

The total cost of the work in the field amounted to \$11,309, of which \$1,500 was paid by various State organizations. Including the cost of the work in the field, the preparation of reports, and transportation and supplies, the field work has cost the Department on the average \$3.26 per square mile, or about 51 cents per 100 acres. This is exclusive of the cost of publication. It is doubtful if the expense of the work in the field can be reduced in the future, and it is likely that it will even be increased somewhat. The cost of the preparation of the reports, however, will be considerably reduced; as, with the

larger number of field parties, it will be feasible to make such assignments as shall keep most of them in the field for much longer periods than heretofore. Parties can be transferred from Northern States in the summer to Southern States in the winter, and in this way the average length of the field season per party may be extended. This will reduce somewhat the total cost of the work per square mile.

ORGANIZATION AND TRAINING OF FIELD FORCE.

For administrative purposes the soil survey has been divided broadly into an Eastern division and a Western division. It was at first intended to put all the work east of the Mississippi River into the Eastern division, and all west of that river into the Western division, and this may yet be done, but the real separation is now based upon the character of the work, as the Western work has been confined almost exclusively to the irrigated areas, where the use of irrigation water and the frequent occurrence of alkali give problems of a distinct character seldom met with in the East, which require special training and special apparatus.

During the summer of 1900 five parties were in the field as long as the conditions were favorable for field work, or until the middle or last of November. Two of these parties were in the irrigated districts of the West, and three were in the Eastern States. The parties consisted of two men each, with a team and suitable instruments, but without a camping outfit, as the work was generally confined to well-settled districts.

By the 1st of December the parties had all returned to Washington, and the examination of the specimens and the preparation of their reports were well under way. The maps had been prepared in the field as the work progressed, but these were given some necessary revision and put in shape for the lithographer.

Foreseeing the probable extension of the soil-survey work, as recommended in my last report, and the necessity of training the younger men for principal field assistants, much care and attention were given to their laboratory training and their reading, and during the winter a seminar was regularly held once a week at least, and a systematic course of instruction given by the experienced men in the Division of Soils, with occasional talks by men from other Divisions in the Department on related lines of work. This method of instruction proved to be exceedingly profitable and instructive to all who attended. Unfortunately, there is no course of instruction in any of the colleges and universities which gives the knowledge or experience that will fit men for this line of soil work, and such training in the Division was considered essential in the organization of an efficient force.

When it became certain that an extension of the soil survey would be provided for, a number of men with the best possible education were selected, and two large parties were organized on April 1 for the thorough training of the men in the field methods. One of these was located in Prince George County, Md., and the other in Iredell County, N. C. With the concentration of all the Eastern men at these two points, a considerable area was surveyed in each, and the men were well trained in the field methods by July 1, when the reorganization went into effect. At that time eleven parties were organized, three in the West and eight in the Eastern States, provision being made for frequent and careful inspection of the field work. The results have proved a most gratifying success, and the organization of the field force is considered particularly strong.

PURPOSE OF A SOIL SURVEY.

It seems hardly necessary to touch upon the purpose of a soil survey, as this has been dwelt upon at length in previous reports and publications, and is clearly shown in the results that have been attained. That these results have been of value to the communities and to the country at large has been attested in many gratifying ways. Requests for the extension of the work have come from prominent and thoughtful men in nearly all the States and Territories, and from those interested in many of the large agricultural interests, such as sugar beets, tobacco, wheat, truck, rice, fruit, and especially from many areas where peculiar conditions of soil, climate, transportation, or labor make it necessary to introduce new crops or new methods for successful competition in the markets of the country.

Our parties of trained soil experts, remaining as they do from three to nine months in a district, visiting almost every foot of the area and mapping what they find, studying the methods and conditions, meeting the people and learning of their successes and failures, can not help acquiring a fund of information relative to the soils, crops, and methods, which should be a basis for the introduction of new crops or of improved methods. The field men have at all times the cordial support and all the resources of the laboratories of the Bureau of Soils and of the other scientific Bureaus and Divisions of the Department.

Demands have been made on the Bureau for the extension of the soil-survey work to Alaska, Porto Rico, Hawaii, and more recently from the War Department for trained men for similar lines of work in the Philippine Islands. The lack of a sufficient number of trained men has prevented an extension of the work to any of these areas heretofore, but it is believed that these demands may be met in a short time.

DETAILS OF THE FIELD WORK.

WESTERN DIVISION.

The Means party.—Work was continued in the Fresno area until August 10, when about 640 square miles had been surveyed. Mention was made of the results attained in this work in my last report. In September the party moved to Santa Ana, Orange County, Cal., and surveyed about 300 square miles. Mr. Means met with an accident soon after his arrival there and his assistant, Mr. Holmes, was put in charge of the work. The area surveyed there extends from the foothills to the Pacific Ocean, the main part being formed by the vast delta plain of the Santa Ana River. In that portion of the area above the 70-foot contour there is little or no alkali, and the lands are well adapted to citrus fruits and nut trees. Below this elevation the low lands are devoted either to alfalfa or natural pasturage and to important special industries of celery and truck growing. The fruit industry is hardly known in this portion of the area.

Nine different types of soil were recognized, each with distinctive agricultural values and best adapted to different kinds of crops. The soils of the high lying portions of the areas are, as a rule, well drained, and owing to the small amount of water available for irrigation and the care which has to be exercised in the use of it very little alkali has been found. The cementing of the canals and ditches to conserve the water gives an object lesson of the practical value of care and economy in the use of water on soils of this character in preventing the rise of alkali.

The Gardner party.—The area in the Sevier Valley was finished during the first months of the fiscal year, the principal results having been given in my last annual report. Upon the completion of this the party moved to Ogden and surveyed and mapped about 310 square miles, mainly in Weber County, Utah. This area is divided into two agricultural districts—a broad delta plain, upon which Ogden is situated and in which the principal irrigation is carried on, and an upland portion composed of foothills and mountainous land. In addition to these, there is an area of nearly 100 square miles of recent delta, formed by the recession of the Great Salt Lake since the early surveys were made in 1858. This land is now so full of alkali that no cultivated crops are grown upon it.

The principal crops of Weber County are peaches, pears, prunes, plums, sugar beets, tomatoes, and other canning crops. Eight types of soil were recognized and mapped, each having more or less distinct differences and adapted to different agricultural interests. The prevailing type is the Fresno fine sandy loam, which covers about 43 per cent of the area. It is the most important soil agriculturally, as it is adapted to the greatest variety of crops. There is, however, trouble in this, as in most of the other soils, from alkali and seepage water. Lime hardpan extends under considerable areas of the delta soils and occasions some trouble, and it has been the subject of investigation in the laboratories of the Division. The irrigation water of the district is exceptionally good and free from alkali. There is more than enough water to irrigate all the lands within the area, provided it were distributed at proper seasons of the year. Unfortunately, however, the larger portion of it comes in the early spring, and there is frequently a shortage during the growing season. Plans are being considered for a large storage reservoir to equalize the distribution and to insure against seasons of drought and low water. Many of the canals run over deep sandy soils, with no protection against seepage, and Mr. Gardner estimates that fully half of the water is lost in this way. This is not only an unnecessary waste of water, but it is the cause of a large amount of injury by the subirrigation of large areas in which the ground water is so near the surface as to be harmful to crops.

The whole area surveyed contains about 198,400 acres, of which 137,000 acres could be irrigated. There are actually about 40,000 acres under irrigation. In about 83,000 acres there is so little alkali that their use for cultivated crops would be absolutely safe. About 16,000 acres have sufficient alkali to make their cultivation at least dangerous, while there are 99,000 acres containing too much alkali for crops. Good lands in this vicinity are worth \$100 an acre, and when set with valuable fruit trees much more than this, so that the importance of this alkali problem here is apparent. It was shown that underdrainage will remove the alkali and reclaim most of the abandoned land.

The Holmes party.—About 200 square miles have been surveyed in the San Gabriel Valley, California. The problems encountered were purely soil problems, as there is little land injured from alkali or seepage water. The soils are almost altogether derived from granite rocks, disintegrated and carried out by floods. All of the soils are light—sand, sandy loam, and sandy adobe predominating. There are no alkali soils in the valley except a few small spots at the narrows, where the San Gabriel River leaves the valley.

The depth to standing water is great, and the difficulties of obtaining water enough to keep the crops alive during the past dry years have been the cause of much expense.

The principal crops are grain, citrus fruits, a small acreage of stone fruits, and grapes. The valley at one time was largely planted to grapes, but the California vine disease caused the loss of nearly all the vineyards.

The most important problem which was encountered was the question of fertilizing the soils. California has no fertilizer-control law. Numerous brands of fertilizers are manufactured, each with a special object in view, and all are sold at high prices and with no guaranty but the manufacturers' analyses. The farmers are using large quantities of these fertilizers, in many cases unnecessarily and in most cases without discretion, but in the hopes of supplying the requirements of the plant and of increasing the yield of fruit. There is great necessity for information on these points, and this information can only be gained through extensive plot experiments. The soil maps will show the best places to carry on this experimental work. Investigations in this line by some one competent to undertake such studies should be started at once, and the excessive application of fertilizers should be stopped unless the necessity of such large applications is proved by experiment.

The Jensen party.—On April 15 a soil survey was started in the Yakima Valley, Washington. The soils were found to be very uniform, the predominating type being a fine sandy loam. They are derived from sediments deposited in the old John Day Lake, a large body of water which covered an extensive area in Washington, Idaho, and Oregon in post-Tertiary times, and to this fact is due their uniformity. Only where stream action has disturbed and reworked the sediments, or where wind has accumulated the sand, is the almost perfect uniformity broken.

Frequent mention has been made by agricultural investigators of the alkali of the soils in the Yakima Valley. The area of alkali land which was found by our parties is very small when compared with the area which has been irrigated, but the land which is damaged is near Yakima and is the most valuable land in the valley, owing to its proximity to town and the ease with which it can be irrigated. Under the Sunnyside Canal, below North Yakima, practically no land has been damaged yet, but there is alkali in the subsoil which may rise to the surface in low places. Excessive amounts of water for irrigation are constantly being used, and the subsoil is rapidly filling with seepage water. If this rise of subsoil water goes on much longer land will suffer. Only a small percentage of the available land is irrigated at present, and it is hoped that the dangers of overirrigation may be shown so clearly that land which is now threatened will be saved.

The Lapham party.—About 216 square miles were surveyed around Hanford, Cal. The most important problems encountered in this section are those of seepage water and alkali. All of the land is low, most of it being in the slough country along the axis of the San Joaquin Valley. The drainage is into Tulare Lake and into the San Joaquin River, by way of the sloughs which connect the Kings and San Joaquin rivers. During the winter and spring months the sloughs and streams fill with water and soak the subsoil so that standing water is found at less than 6 feet from the surface of the ground. Everything possible is done to assist this filling of the soil with water,

for the success of the following crop is supposed to depend upon the water which is thus stored in the soils. The natural drainage by the sloughs is often artificially blocked by dams during this period, and the irrigation canals continually carry water onto the land. There is no question but that the crops are benefited by the water stored in this way at certain seasons, but at the same time some of the most valuable land is being ruined by the rise of alkali, due to the high water table. Already large areas are left out of cultivation, and unless the present practices are changed further damage will ensue. Instead of damming the drainage systems, everything possible should be done to carry off the winter's excess of water, and instead of depending upon subirrigation to furnish the needed water supply, the water should be applied by irrigation from the top of the ground, which would tend to drive the alkali down. In order thoroughly to reclaim the district and insure against further damage, a drainage district should be formed and outlet canals be dug for the free passage of the excess of water, and the sloughs which are now dammed should be opened.

If winter irrigation is to be practiced, it should be from the surface, for subirrigation in such soils, particularly if the level of the standing water comes to within 4 or 5 feet of the surface, involves serious danger of the rise of alkali.

There are large areas of land already alkaline which could be reclaimed at a profit, and it is hoped that these investigations will make this point so clear that the people of the district can be prevailed upon to make the experiment of reclaiming small areas at least for demonstration.

EASTERN DIVISION.

The Dorsey party.—During the first part of the fiscal year the Lancaster area was completed, having been started during the latter part of the previous year. Lancaster County, Pa., was selected for the work, as it is an important tobacco-producing section, and is one of the oldest as well as one of the finest agricultural districts in the country.

The area surveyed consists of a broad limestone valley, with sandstone and shale ridges of sedimentary rock, and, in the southern part, of the Piedmont plateau of crystalline rocks. The surface is gently rolling, and is well watered by numerous streams. The most important soils are the Hagerstown loam and the Conestoga loam, each covering nearly one-third of the area surveyed. They are both formed from limestone rock, the former from a hard massive limestone and the latter from a softer schistose limestone, making the soil soapy or greasy to the touch. Both are excellent soils for wheat and corn and are typical soils for the grade of tobacco grown in Pennsylvania. The Edgemont stony loam is similar to the mountain peach soil of western Maryland, which has become famous for the production of a fine quality of late peach. It is unsuited for wheat or general agriculture. The Donegal gravelly loam occurs near the Susquehanna River, and it is upon this that the fine wrapper leaf tobacco has been produced, similar to the Connecticut leaf, it being the only soil in the area which will produce this grade of tobacco. Other soils were found of less importance either from their slight extent or from their small agricultural value. The difference in the commercial value of these lands is very great. The best limestone soils are worth from \$125 to \$250 an acre, while some of the other soils have merely a nominal value.

It is thus seen that even in this thickly settled and long-established community there is a great variety of soils, adapted to different agricultural interests, and the investigations indicate that new industries may be established on soils that at the present time are held in slight esteem.

Important lessons are taught from the industry of the people, which would be of immense practical value if applied in other localities. Active steps have already been taken to follow up this survey with an attempt to introduce a better type of tobacco on certain soils which closely resemble some of the Cuban soils, as will be pointed out in another place.

The party proceeded from Lancaster, Pa., to Dayton, Ohio, where a soil survey was made of Montgomery County, comprising an area of 480 square miles. Montgomery County is one of the prominent agricultural counties of the State, and the center of the Zimmer Spanish cigar-filler tobacco district. The soils of the county are derived from glacial débris or glacial material which has been reworked to some extent by stream action. The county consists of a broad rolling upland, which is cut by many broad and beautiful valleys along the principal streams. The soils of the upland are the slightly weathered products of the great sheet of till that was left by the ice. These soils are locally known as "sugar-tree" lands, and are heavy clay loams, which produce the finest quality of Zimmer Spanish tobacco. Formerly they were covered with a thick forest growth and in many places by great quantities of bowlders. In addition to producing a fine quality of tobacco, these soils have long been noted for their general agricultural value. Occupying slight depressions in the uplands occur the black soils, which undoubtedly represent former swamp deposits. These soils, when thoroughly drained, make desirable farm lands and produce a fair quality of tobacco. The soils of the river bottoms have been to a large extent deposited and reworked by stream action and consist of sandy and gravelly loams. The heavy black loams are famous corn lands, while the gravelly loams are perhaps the finest farming lands found in the county. It was on the gravelly loams that the tobacco industry was started in the early part of the last century, and, while the sugar-tree land produces a finer type of tobacco, it is still one of the principal crops on the gravelly bottom lands.

In the spring of 1901 the party moved to Statesville, N. C., where a training camp was established and an area of 800 square miles surveyed. The soils in the Statesville area are residual soils, derived by the slow process of subaerial decay from granites, gneisses, schists, and other metamorphic and igneous rocks. Large bodies of Cecil clay and Cecil sandy loam were found in the area. These soils are used at present for cotton, corn, and wheat. Formerly bright tobacco was grown on the Cecil sandy loam, and it was thought for some time that the industry would prove a success, but competition with other areas better adapted to growing this tobacco drove the industry from this section of North Carolina.

Small areas of Durham sandy loam were mapped, which is an ideal bright tobacco soil, but this soil does not occur in sufficiently large areas to warrant the development of the bright tobacco industry. It was all the time apparent during the progress of the survey that the agricultural possibilities of both the Cecil clay and the Cecil sandy loam have never been realized. Land is so plentiful and so cheap that when one field is exhausted by injudicious cultivation and by

lack of sufficient fertilization it is abandoned to grow up in pine and another area is cleared to be in turn exhausted and abandoned.

There is a scarcity of good farm labor. The majority of the farmers have not the means to cultivate properly one-fifth of the land they own, yet they attempt to cultivate it all, with the result that not more than one-fourth of a full yield is harvested. In some sections of the area, as about Mooresville, successful farmers have taken worn-out farms and in three years made them pay for themselves, besides greatly improving the productiveness of the soil. This proves the possibilities of some of the really fine areas of farm land of the Statesville district, and should be given considerable notice as an example of what improved methods of cultivation will accomplish.

It is the purpose of the North Carolina department of agriculture to follow up this work closely, and the soil map will be used as a basis for further investigations as well as for the location of another experiment test farm.

The party next proceeded to Virginia, where a soil survey was started in Bedford County. This area includes a portion of Piedmont, Virginia, and the Blue Ridge Mountains. The soil types recognized are residual soils derived from the decomposition of old eruptive metamorphic rocks. The Cecil clay covers the greater part of the central portion of Bedford County and makes a fine grass and corn country. Considerable attention is paid to the raising of cattle, and the region is a good heavy shipping and manufacturing tobacco district. Small areas of Cecil sandy loam were mapped, which in a few instances have been used for bright tobacco.

Mountain lands, of which there are several varieties, possess great possibilities for the development of the apple industry. The county is at present recognized as a prominent apple-growing district. There is great room, however, for the further development of the apple and peach industry, and soil types are being recognized and mapped which are in every way identical with the famous pippin, winesap, and other noted apple lands of Albemarle County.

The Bonsteel party.—In the first part of the fiscal year the soil survey of St. Mary County, Md., was completed, it having been begun in the latter part of the preceding year. After this, Calvert County was surveyed, the soils being the same in each area, but of different relative extent. St. Mary County covers an area of about 360 square miles of land surface, and Calvert County of about 218 square miles. Both counties lie wholly within the area of the coastal plain, and are of unconsolidated material, originally laid down in nearly horizontal beds under water. The upland portions now range from 90 to 200 feet above tide level, and are very much eroded by cutting down through the successive layers, exposing eight types of soil. These soils range in texture from the stiff clay lands of the Leonardtown loam and Sassafras loam to the loose incoherent sands of the Windsor sand formation and the gravels of the Susquehanna formation.

The Sassafras loam is in fairly good condition, and produces fairly good crops of wheat and corn. The Leonardtown loam, which is a very strong clay soil, should be equally well adapted to these crops, and should have nearly the same value as the Hagerstown loam of the Lancaster area. The soils, however, are generally acid and are very imperfectly cultivated by inefficient labor and poor methods. They range in value from \$3 for uncleared land to \$10 as a maximum price for cultivated areas.

The results of the survey indicate that these lands can be easily and cheaply reclaimed, and a few cases in which this has been done show plainly that they will then become exceedingly fertile and profitable. There is very little ready money in the county and some of the farms are heavily mortgaged, which, with the scarcity and inefficiency of the labor, has a deterrent effect upon improved and more thorough methods.

Large areas of Norfolk sand were mapped, which is a typical soil for early trucking, but the industry has not developed to any very great extent in either of these counties. There are numerous waterways, with cheap transportation by water to the markets of Baltimore and Washington. The Windsor sand of the old pine barrens is used to some extent now for peaches, and the trees are healthy and long-lived and produce a fruit of high color. About 23 per cent of the area in St. Mary County and about 11 per cent of Calvert County consist of meadow lands, which, if underdrained and properly cultivated, would produce excellent corn and wheat, but in their present state they are lightly estimated.

On the completion of these areas the party moved to Kent County and surveyed an area of about 315 square miles. This area is also within the coastal plain, and many of the soils are similar to those just described. There is less of the meadow land and none of the Leonardtown loam, but large areas of Sassafras loam were mapped, and these soils and other soils in this area are in a high state of cultivation and are used for crops that seem to be particularly adapted to them.

In the spring of 1901 the party made a survey of Prince George County, Md., comprising an area of 460 square miles. Several new men were added to the party at this time for training in field methods. The area lies north of St. Mary and Charles counties, and is practically all within the coastal plain. All of the soils are encountered here that were found in St. Mary County, and several new and important types were discovered. In this area, also, the soils are not used entirely for the crops peculiarly adapted to them.

There are great possibilities in the specialization of crops in this area. It is quite close to both the Washington and Baltimore markets, and there are many industries that could be developed that are now but slightly recognized. The soil maps show the distribution of these different types, and should form a basis for intensive cultivation of a variety of crops. There is an opportunity for stock raising on the Leonardtown loam and on the Sassafras loam; for small fruits and truck farming on the Norfolk sand, the Malboro sand, and the Collington sand; for wheat and corn on the Collington sand and the Susquehanna clay loam, and for fruit growing on several of these and on some of the other formations.

The Smith party.—In the summer of 1900 a soil survey was made from Raleigh to Newbern, N. C., and an area of about 100 miles in length, averaging about 9 miles in width, comprising a total of about 900 square miles, was surveyed. Sixteen distinct soil types were recognized and their agricultural value determined. This great variety was due in large measure to the proximity of the Neuse River, which has considerably altered the materials within a few miles of its channel.

The area surveyed extends from the Piedmont plateau to the tide-water region. In the Piedmont plateau the soils are derived from residual decay of metamorphic rocks, and are adapted to cotton and

general agricultural purposes. On the coastal-plain portion, which covers the greater part of the area, sandy and silty soils predominate, adapted to cotton and to the production of a fine quality of bright tobacco. In the lower part of the area around Newbern the trucking industry has been largely developed on the light sandy soils of that area. The relation of these 16 types of soil to crops was everywhere quite pronounced, and in the report the special adaptations were pointed out and the relative value of each soil for the different classes of crops was shown. There are considerable areas of muck soils, which should be used for the special crops adapted to such soil conditions. There are also large areas of pocoson and savanna soils, which will require extensive improvement in the way of drainage before they can be made at all productive or safe for crops. There is also a considerable area of Garner stony loam, which consists of from 6 to 15 inches of a sandy loam, containing from 40 to 60 per cent of rock fragments and gravel, underlaid by a stiff red brick clay. The overlying soil material is firmly compacted and has the effect of macadam, rendering cultivation exceedingly difficult and making the soil adapted only to forest growth. The Selma silt loam is the most valuable soil for bright tobacco, especially in its sandy phases on the ridges that traverse the area. In its siltier phases it is one of the finest cotton soils of the locality. Altogether, the soil maps are full of detail, as the types very often are in small areas, but as their agricultural values are very marked the possibilities are shown of improvement through the adaptation of crops particularly suited to each type of soil.

In May, 1901, the party proceeded to Pennsylvania and started a survey of the Lebanon area, but the results of this work will not be given at this time.

FIELD WORK IN PROGRESS AND ARRANGED FOR.

In the latter part of June, 1901, parties were organized and sent to Chautauqua County, N. Y., and Allegan County, Mich. The areas surveyed during the fiscal year, however, were so small that no results can be given at this time. Other parties were sent out the 1st of July to Montgomery County, Tex.; Montgomery County, Tenn.; Salem County, N. J., and Ada County, Idaho, and arrangements have been about completed for work in the fall of 1901 in Georgia, Florida, Mississippi, Louisiana, and in the Colorado Desert of southern California, as well as in Arizona.

DRAINAGE INVESTIGATIONS.

Attention has frequently been called in the reports of the Division of Soils to the possibility and feasibility of reclaiming alkali lands and preventing the deterioration of lands from alkali by efficient underdrainage. This has been dwelt upon by other writers and presented in the strongest possible terms as the most rational and safe method of solving the alkali problem. Unfortunately, on account of the conservatism of growers, these recommendations have received little or no attention, and there is no general recognition of the possibilities of controlling the problem in this way. Owners who are not at present troubled with alkali do not appreciate the necessity of protecting themselves; and it is a curious fact that just before the alkali becomes so strong as to prevent profitable cultivation the crop yields are the largest. After that the lands deteriorate so rapidly that the

owner is disheartened, and is not inclined to invest money where ordinary means of cultivation have failed to produce profitable returns. It was necessary to make a practical demonstration of the possibilities of growing Sumatra tobacco in Connecticut to get the industry started. The recommendations of the Department in this regard were unheeded until the correctness of its predictions was thus demonstrated.

Attention was called to the possibility of reclaiming the alkali soils of the Yellowstone Valley in Bulletin No. 14, and, in Report No. 64, the desirability of reclaiming the great alkali flat in the Salt Lake Valley, covering upward of 60,000 acres of redeemable land, was pointed out. I feel that it will be necessary, in order to secure the greatest benefit from the soil investigations, to make an actual demonstration of the practicability and efficiency of underdrainage in the reclamation of these alkali tracts.

In 1864 the government of India published correspondence relating to the deterioration of lands from the presence of alkali, in which the following statements were made:

In the districts reported there were 59 villages in which the agricultural industries had been wholly or in large part destroyed by the rise of alkali. By the year 1850 it had made great progress and was becoming alarming. From that time until 1858 it increased yearly with frightful rapidity. The cause was attributed to the rising of the springs throughout the tract to within a very short distance of the surface of the soil. First of all is the development of the alkali; second, condition of dried swamp; third, inundation. Water in these valleys used to be about 40 fathoms (60 feet) below the surface, and in 1858 it was 2 or 3 feet. No temporary improvement can arrest the natural course of things, and notwithstanding accidental checks, the work of deterioration if left to itself will gradually complete itself, the completion depending upon the amount of land the amount of water can affect. Attention is called to proper construction of canals and irrigating ditches, so as to prevent loss from seepage, and the necessity of economy in the use of water. With such precautions taken underdrainage would be a sure means of reclaiming the lands from alkali and seepage waters. There is no economical substance practicable within the means of cultivators of any section capable of remedying the saline matters, but wherever drainage can be accomplished the thorough working of the surface soil, with abundance of water from the canal will, if continued for a couple of seasons, dissolve and carry away the noxious salts; but the drainage must be efficient and rapid, otherwise the salt will merely dissolve and be again deposited in the same place. Drainage will prevent as well as cure, and even a small decimal percentage will surely and in no very long time accumulate to 3 or 4 per cent or more, according to the circumstances of the ground in relation to evaporation and drainage. Wherever alkali comes from, drainage is the only and efficient cure.

With these plain warnings from the reports of English engineers to the government of India, it would seem that the people and the government itself had been sufficiently well informed of the gravity of the situation and of the means for the removal of these causes. Yet, in the reports published by the government of India in 1870, and even as late as 1881, it is stated that underdrainage had not been attempted, and that the recommendations of the engineer officers ten or twenty years before had not been carried out, and that the alkali question was becoming more and more serious and alarming, while the government was being called upon to support large numbers of people who had been rendered destitute by the encroachments of this evil.

In view of such marked examples as this of the ultra conservatism of agricultural communities, and the fact that the recommendations of this Department are little heeded, I am becoming more and more convinced that in order to carry the lessons of the soil survey home to the individual it will be necessary for the Department to undertake a practical demonstration of the efficiency of drainage in the reclamation of alkali lands.

Plans were made for such a demonstration during the latter part of the fiscal year, with the cooperation of the Utah experiment station and some of the public-spirited people of that State. It was proposed to underdrain a small tract of 10 or 20 acres and cultivate the land in a proper way for two or three years, to note the improvements in condition until agricultural crops could safely be grown. The expense of underdrainage when undertaken on a considerable scale should not exceed \$15 or \$20 per acre, so that the cost of a demonstration of this kind would not be great. Unfortunately, the plans were interfered with, and the work has had to be temporarily abandoned. It should, however, be taken up at the earliest practicable time.

A great interest has been taken in this line of investigation in Montana, Utah, Arizona, and California, the places where the soil survey has been carried on. A great deal of interest has been expressed in this enterprise, particularly in the Yellowstone Valley, at Salt Lake City, and at Fresno, and plans are now under consideration for a demonstration of this kind at these places.

The actual field expenses of such an experiment would hardly amount to more than the cost of publication of a bulletin containing recommendations, which might receive but little notice. The demonstration itself, however, if definitely carried out, would be of infinitely more value, as it would be an object lesson for the people, and could not fail to arouse an interest which would spread throughout the community. While the Department is spending thousands of dollars for the investigation of these problems it does not seem as if the matter of expense of such demonstrations should be considered, provided, as in this case, it seems necessary to use this means to inaugurate better methods which will be of immense benefit to the localities.

SOIL CLIMATOLOGY.

The Division of Soils was originally organized in the Weather Bureau under a clause to "investigate the relation of soils to climate and organic life." When for administrative purposes it was reorganized as an independent division of the Department this work was still recognized as of paramount importance, and is still authorized under the first clause of the annual appropriation bill. It was pointed out that the soil, being the receptacle of the rainfall and maintaining the only immediate water supply for crops, is a factor in climatology, and as different types of soil maintain different quantities of water it may be assumed for all practical purposes that crops growing on these different types of soil, even with the same rainfall and temperature, are really under different climatic conditions. This is the basis of much of the specialization of agriculture and a principal cause of the local importance of certain districts for special crops, such as truck, tobacco, and fruit, as well as for the distribution of such farm crops as corn, wheat, and grass. The recognition of this fact is largely the basis of the soil survey and for the highest prosperity of agricultural communities. Furthermore, it is a well-known fact that the degree and character of cultivation have a marked effect upon the moisture supply of the soil and thus control in no little degree the climatic conditions under which the crop is grown.

In certain sections of the country and on certain soils, notably in California and the Northwestern States, the condition of the soil for various crops and the probable yield can be fairly estimated from the water supply in the soil some weeks or even months before the harvest.

In former reports I have called attention to the progress made in the perfection of instruments for recording the moisture content of soils loss in the field and for determining the tendency to evaporation or of water from plants for which an adequate moisture supply must be maintained. Stations were established in different parts of the country and on important soil types for these moisture records. From these records it was possible to show the normal variations which could occur in any soil between the conditions of excessive wet and drought, and the possibilities were pointed out of determining a numerical relation between the soil moisture and the sunshine, temperature, humidity, and wind velocity, which would enable the climatic condition to be expressed by some figure, representing the relative condition of plant growth at any place in terms of the most favorable condition heretofore observed. This is in no way covered by the work of the Weather Bureau, which is concerned largely with dynamic meteorology, or the laws and prediction of storms, and will involve an entirely different equipment and an independent set of observations taken in the fields and soils of growing crops, rather than in cities and towns.

The value of such observations, taken by a corps of experts trained to observe and understand plants as florists understand greenhouse plants, can not be estimated. Reports based upon such observations in a period of drought, such as the Middle West has just experienced, would show the actual conditions existing far more accurately than is now possible. Furthermore, as the drought limit is approached in any soil, suggestions can be made for preventive measures in cultivation or cropping which may save many bushels of grain on any farm which in the aggregate for all the farmers who would heed the warnings sent out from Washington would save an immense sum of money to the agriculturist.

In my report for 1899 I stated that the investigation had progressed far enough to establish the preliminary plans upon which this work should be begun, and that it was useless to go further until the time arrived for a considerable extension of the work, to make it of value at least to certain industries.

In my opinion, the time has come when this work should be again taken up on a scale commensurate with the extension of at least two or three crop interests. I have therefore recommended an increase in the appropriation for next year, intending, if this is allowed by Congress, to recommend that \$25,000 be set aside for this work under the immediate direction of some well-trained and eminent soil physicist, subject to my general supervision. I feel satisfied that the immediate benefit to the farmers will amply repay the expenditure of this sum.

SOIL TECHNOLOGY.

The field parties see many opportunities of improvement in the crops or methods of cultivation in the districts in which they are located, which they have not time, in the rapid progress of their work, to demonstrate, and for which they must rely upon recommendations in their rather brief reports. Such recommendations seldom accomplish the object sought, on account of the well-known conservatism of growers. It may be that the evidence indicates the need of drainage, or the correcting of acidity in the soil, or may suggest the introduction of new and profitable crops. Such suggestions are rarely acted upon in that thorough manner necessary for a practical demonstration, and

it therefore seems advisable, if the full value of the soil survey is to be realized, to organize a division of soil technology to work out the suggestions and demonstrate the efficiency of new methods or the feasibility of introducing new crops, as has been done so successfully in the case of the tobacco work.

I am not ready to make a specific recommendation at this time, as it is difficult to find trained men for this work in this country, and the success of such an organization would depend largely upon the personnel of the force. It would seem that some of our agricultural colleges should turn out such men, but they apparently have not done so. There are practical men who could carry on such work under direction of our scientists, but they are usually so successful as managers of estates that they can not be induced to accept a place for the salaries allowed by Congress in this Department. It seems to be necessary, in this as in other lines, to train the men ourselves.

TOBACCO INVESTIGATIONS.

In my last report I called attention to the success of the exhibit of American-grown leaf tobacco at the Paris Exposition and the number of awards given. After the installation of the exhibit and the work of the jury of awards had been completed, Mr. Floyd, the tobacco expert of the Division, spent some time, under orders from the Secretary, visiting the foreign markets, particularly in Paris, Bremen, Amsterdam, and London, where large quantities of our domestic tobaccos are sold or where we ourselves purchase leaf for our own use. The information gathered in this way of the character of the tobacco from all over the world with which we have to compete in our foreign trade, of the requirements of those markets, and of the methods of selling under the Regie system prevailing in certain of the European countries, promises to be of great value in the investigations which it is planned soon to take up of the export types from Virginia, North Carolina, Kentucky, and Tennessee.

Upon his return to this country, Mr. Floyd took active steps to start some investigations on the improvement of the Pennsylvania leaf, with the object of seeing what could be done with it, and the further object of introducing a more desirable filler leaf, if such a step seemed necessary for the building up of the trade in Pennsylvania tobacco. A soil survey had been made of the principal tobacco districts of Lancaster County, as a basis for the possible introduction of new varieties. In the preliminary work of manipulating the present style of leaf grown in Lancaster County, a different method of fermentation was tried, in which the tobacco is fermented in bulk, according to the practice in Cuba and Florida, which had been successfully used on the Connecticut leaf the year before. Fermentation by this process is completed within forty or fifty days, under the constant supervision of an attendant, who turns the bulk from time to time, and it is thus possible to watch the progress of the fermentation and modify the conditions if circumstances seem to require it. This is a decided gain in point of time, and is much less expensive than the old method of case fermentation, where the tobacco was set aside for from six to nine months in a tightly packed case, in which it was chance whether the tobacco would ferment properly and whether it would escape injury by black rot. The first experiment made was on an old crop which had not fermented by the usual case method, but which had developed a considerable amount of black rot. Bulk fermentation

proved perfectly successful, the quality of the leaf being greatly improved, and no further development of the black rot appearing while the tobacco was in bulk or afterwards. The results of this experiment seemed to be of such marked value that several of the leading packers of Lancaster opened their warehouses to us and installed at considerable expense proper facilities for handling the crop. As a result of this, during the winter and spring of 1901, over 4,000,000 pounds of tobacco was fermented in bulk under our direction, with a total loss of not more than 35 pounds from black rot and all other damage. It is a difficult matter to give any close estimate of the usual damage from black rot, as the dealers hesitate very often before admitting that there is any at all, but a conservative estimate would show a loss annually of at least \$500,000 per year in the Pennsylvania crop, and in some years it must considerably exceed this figure. The success of this method of fermenting the tobacco, both in improving the quality of the leaf, which is generally conceded, and in controlling the dreaded black rot, about which there is no longer any doubt, is assured, and it is confidently predicted by the packers themselves that the new method will entirely supersede the old, especially where large crops are to be handled. If this is done it will mean a saving to the State of Pennsylvania alone of an amount far exceeding the present cost of the whole Division of Soil.

In the early spring arrangements were made with four prominent growers on different soil types in Lancaster County to introduce some of the finer Cuban seed, and these experiments are now progressing under our control, the latest reports of the work being very promising. It will, of course, be several months before the actual results can be determined, but if they seem to warrant it, all necessary attention will be given to the important experiments at this point, in the endeavor to raise the quality of the Pennsylvania leaf.

In my last report I announced the complete success of the small experiment of growing a fine type of Sumatra leaf on certain soils in the Connecticut Valley. This experiment had been made on a small tract of one-third of an acre, and it was thought best to extend it to a larger area, in order to see if, under the conditions prevailing and with the large cost of production, the tobacco could be profitably raised in the valley. Accordingly, in the spring of 1901, arrangements were made with a number of farmers in Connecticut and Massachusetts, in areas as widely separated as possible and on typical soils which it was thought could be used for the Sumatra tobacco, and nearly 43 acres were placed under our immediate control. It was agreed that the farmers should furnish all needful material and labor, and that the Department should assume direction of affairs in the practical management of the crop. The understanding is that all the necessary information regarding the actual cost of the work shall be at the disposal of the Department to publish, and that the Department itself shall have the right to sell the crop for the farmers, so as to insure an absolutely impartial judgment from the leaf dealers as to the quality and value of the product. It will, of course, be some time before the actual results of this large experiment will be available for publication. I have estimated roughly, however, that about \$20,000 has been invested on the part of the farmers, with no expense whatever to the Department except that of supervision.

The experiment has attracted a most remarkable interest, and prominent growers and packers have visited Tariffville, the Depart-

ment's headquarters for this work, from many places in Connecticut and Massachusetts, as well as from Pennsylvania, New York, Ohio, Wisconsin, and Florida. The present indications are that the crop will yield at least double the cost of production, although nearly three-fourths of the original cost is in what might be termed permanent improvements; that is, in the erection of the shade, which will last from five to ten years. It is probable that within two or three months of the time of the publication of this report the data will be available for the issuing of a special report on this experiment, giving the methods and cost of production and the value of the crop, and it would therefore be unwise at this time to attempt to forecast the results. It is certain, however, that they will amply repay the labor and expense to the Department.

The following, from the Tobacco Leaf of August 7, 1901, under the title of "Shade growing a great success," gives a fair statement of the methods employed and of the way in which this experiment is viewed by the trade:

Taken all and all, it has been many a long year since the tobacco growers of New England have had such cause for self-congratulation as exists to-day. Events have developed this year, which not only give assurance of continued demand and paying prices, but before the astonished grower a vista has dawned which in possibility is limitless. This, of course, refers to leaf production under cover, an industry which, although in its infancy, has now been carried beyond the experimental stage and gives promise of big returns. In the history of the world there has rarely been an important industrial movement that has not had a strenuous opposition to overcome. The opposing forces invariably have arisen from ignorance, prejudice, or vested interest—sometimes a combination of all three. The growing of wrapper tobacco under shade in the Connecticut Valley points to an early revolution in methods which have been accepted and religiously followed for generations; hence it is not surprising that this scheme also should have met, and still be meeting, with its share of ridicule and prejudice. Such sentiments, however, now seem destined to be swept away, and a merited meed of praise accorded those whose enterprise and intelligence introduced the system to the country.

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The credit of first applying the test in New England belongs, we believe, to Mr. M. L. Floyd, the Government tobacco expert. Last year, under this gentleman's supervision, and with the assistance of Mr. John A. Du Bon, of Poquonock, about one-third of an acre of land was planted with Sumatra and Havana seed varieties, and so successful was the issue that some of the more enterprising growers determined this year to try the experiment on a larger scale for themselves.

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The Messrs. Mitchelson are cultivating on their splendid estate no less than four fields, the aggregate area of which is 18 acres. The largest contains 8 acres, and is admittedly the "prettiest" piece of tobacco ever grown in New England. A description of this, although it is not the most advanced of the lots, will suffice for all.

On entering the inclosure one is amazed at the luxuriant growth, symmetry, vivid greenness, and general beauty of the plants. The proprietors have not topped any of their tobacco, and the curious spectacle is presented of tobacco plants almost uniformly 8 feet high, in full blossom, and nearing the ripening stage. The seed used was Florida Sumatra, and the stalks carry the average number of leaves. The latter run from 20 to 24 inches in length, and from bottom to top are expected to "go" wrappers, and wrappers of the ideal size and shape, giving easily two full "cuts" without waste or heavy stem. The yield of the covered farms is expected to run from 1,600 to 2,000 pounds per acre.

As the leaves ripen they are picked and "strung," just as is done in Sumatra, the bottom first and so on until those at the very top are taken—a dividing period of from three to five weeks. The picking is done by experienced hands, and the stringing by women and youngsters. The lathing and hanging is a very pretty process, and it is expected that the first cut tobacco will be quite fit for removal from the sheds before the later is ready to be run up—a great advantage where both space and help may be limited.

The framework of the covering consists of strong upright posts and crossbeams of sawn timber, liberally connected for the double purpose of giving ample support to the cheese cloth and stability to the entire structure. Great care is used in spreading and fastening down the cloth, and from end to end of this 8-acre inclosure there can scarcely be found a hole large enough for a fly to pass through. Nor is this the least of the advantages of the covering. Not only are all insect pests kept out, but the tender leaves are sheltered from hail and wind and a continuous and rapid growth secured through the retention of moisture and an even high temperature. The action is that of a modified hothouse, with the difference that the rain falls unimpeded on the growing plants, and the air passes freely night and day. However, the cloth affords sufficient protection to prevent rapid absorption by the sun, thus preventing the waste of needed moisture and the baking of the soil, and giving a more even temperature for the growth and ripening of the crop. On a hot day the difference in temperature between the shaded fields and the outside is from 12° to 15°; on a cool, cloudy day, from 3 to 5°. The day on which the writer visited the Mitchelson estate the sun was high and strong and the atmosphere clear, dry, and genial. Inside the "tents," however, the air was decidedly moist and oppressive, redolent of rank vegetation and similar in all respects to that met with in dense tropical undergrowths.

Of necessity, the initial cost of the covering is heavy, but as the framework is expected to last from twelve to fifteen years the expense thus divided is materially lessened. Moreover, it is hoped that the cloth itself will last for two seasons, and this is one of the questions which will be determined this year by the Messrs. Mitchelson. The cost of the cloth covering per acre is about \$175; that of the framework and labor about \$125; a total of \$300 or more. From seed to bale it is estimated that the expense to the producer will be in the neighborhood of \$700 per acre. While at first sight these figures might seem high, it is easily calculated how well an average yield of from 1,600 to 1,800 pounds of such tobacco as these covered fields are expected to produce would pay. Beyond question it has been proved that a better wrapper tobacco can be grown in New England than was dreamed of even eighteen months ago. But what has yet to be proved is of even greater importance: Can this leaf be grown at a profit; and if so, will the manufacturers of the country take hold of it? The tobacco being raised at Tariffville is admitted by the oldest and most experienced dealer in New England to be the most perfect in appearance that he has ever seen growing, and up to the present time there seems to be no reason why it should not cure out all right. It will certainly be fine in texture and even in shape, size, and color.

The experiments which are being carried on by Mr. Lemuel F. Graves, of Whately, Mass., are likewise interesting. Unlike the Messrs. Mitchelson, he is not using the Florida seed but seed that was guaranteed to him as being the genuine imported Sumatra article; also he has topped his tobacco just as if it had been grown in the open field. Mr. Graves has half an acre under cover, and additional interest is given to his operations from the fact that he has adjoining this plot a quarter of an acre of the same seed growing in the open. His covered plants, while perfect in leaf, have not grown so straight as those at Tariffville, and in consequence the field does not present the same beautifully uniform and symmetrical appearance. This tobacco was set out between June 1 and 5, and is almost ready for picking. It is also double the height of the outside weed growing beside it, but in other respects there seems little to choose between the two lots. However, should a hailstorm pass over the field or an extra strong wind blow, all resemblance would be at an end. Parenthetically it may be observed here that the Messrs. Mitchelson report that there recently passed over Tariffville one of the greatest wind and hail storms known for years, and while a few plants were knocked over by the wind, not a single leaf was damaged by hail; neither was the cloth covering damaged in any way. Mr. Graves also experienced a cyclone and had some of his plants blown down, but these were promptly strung up and seem to be as thrifty as ever. In this tobacco, naturally spotted leaves seem to be far more plentiful than at Tariffville, although a fair proportion was seen at the latter place.

Even this brief reference to the new industry would not be complete without some appreciative recognition of what the Agricultural Department has done to thoroughly test the system, and of the intelligent efforts of Messrs. M. L. Floyd and H. M. Lott to insure its success. Mr. Floyd is well known to cigar-leaf growers in the different States, but Mr. Lott has spent most of his life in Florida. He has for some four years been in the employ of the old firm of Schroeder & Bon, and has had much experience in shade growing in the Flowery State. He and Mr. Floyd are now devoting the whole of their time to watching the development of the New England covered crops, and both of them speak enthusiastically regarding the future industry.

In view of the phenomenal success of the introduction of Sumatra leaf into the Connecticut Valley, and the control of black rot in the Pennsylvania crop, there have been many urgent demands for help in the tobacco industry in New York, Ohio, Wisconsin, Texas, and Florida. Preliminary steps have been taken to meet these demands, but they are so great that it will take considerable time to extend help even where it is most needed. Active measures are being taken, as announced in my last report, for investigating the possibilities of growing Havana tobacco in Texas, and it is aimed to make this experiment one of the strong features of our work for the coming year.

It must not be overlooked that there is pressing need of investigations in the manufacturing and export types of the Southern States, and there have been many requests for such help on the part of the Department. It has seemed wise, however, to confine our attention to the highly organized industry in the production and handling of the cigar types and get this work well established before the other types are taken up. Just as soon as possible, however, the Virginia, North Carolina, Tennessee, and Kentucky districts will be attended to. Preliminary work is being done in several of the States in the construction of soil maps of the important tobacco areas, and plans are being perfected for the improvement of the types and grades of leaf grown there.

During the spring of 1901 a comprehensive exhibit of leaf tobacco was installed at the Pan-American Exposition in Buffalo, modeled somewhat after the exhibit at Paris, although necessarily much smaller, as the space at our command was considerably less.

Another important line which has been taken up is in the securing of tobacco seeds for Congressional distribution. Contracts have been made with leading growers in the various States to have seeds saved from vigorous, healthy, well-bred plants, and arrangements have been perfected for the distribution of these varieties to the districts to which they are particularly adapted. It is believed that this will be a great improvement over the former miscellaneous distribution of tobacco of all kinds to all districts.

LABORATORY OF SOIL PHYSICS.

The work of the physical laboratory includes the investigation of the physical properties of soils and their economic bearing, the physical examination and mechanical analysis of the soil types established by the field parties, and the preparation and testing of the apparatus used in the field work.

THE REMOVAL OF SALTS FROM SOLUTIONS BY SOIL GRAINS.

It has long been known that finely divided solids have the ability to condense upon their surfaces a small proportion of the dissolved substances contained in the solution with which the solid is in contact. This property is known as "adsorption," and is an important factor in the conservation of plant food in the soil, since it prevents the rapid leaching away of the soluble materials and their consequent loss to the growing crops. This property has never been fully investigated, and it seemed very desirable to subject it to accurate measurement and determine how important this property is in the economy of nature. For the preliminary work crushed quartz rock in a very fine state of division was selected on account of its slight solubility,

chemical inactivity, and prominence as a soil constituent. It was found that the amount of the dissolved salt which is removed from solution by the soil grains increases with the concentration of the solution. A very important feature in this connection is that the amount of adsorption is relatively very much greater for the dilute solutions of concentrations found in Eastern soils.

The nature of the dissolved salt was also found to have a considerable effect upon the amount of adsorption. For example, the solutions of substances which have an alkaline reaction, such as caustic soda or carbonate of soda, are adsorbed to a much greater extent than neutral solutions, such as common salt. The magnitude of this property is shown from the experimental fact that, when the soil is saturated with a solution containing 400 pounds of carbonate of soda per acre, 180 pounds of the sodium carbonate is adsorbed by the soil grains, and it is not moved with the soil moisture so long as the concentration remains constant.

This work is now being extended to include natural soils and the common mineral constituents of commercial fertilizers. Investigation is also being made to determine whether mixture of salts exerts any mutual action on the amount of adsorption.

CONDENSATION OF CARBON DIOXIDE ON SOIL GRAINS.

The adsorption or condensation of carbon dioxide upon the surface of fine quartz particles has also been investigated. The existence in the soil of a relatively large amount of carbon dioxide has been known for some time, and the present work leads to the belief that this is very largely held in the soil by adsorption. Since the amount of adsorption is proportional to the pressure of the carbon dioxide, it is evident that the carbon dioxide can be largely removed from the soil simply by loosening the soil so that the contained gas may escape. The pressure of the carbon dioxide is then reduced and the gas adsorbed will be liberated. This feature is of importance, since recent investigations have led to the belief that the acidity of many soils is due simply to the abnormally large amount of carbon dioxide present in the soil. On the other hand, in some cases it is very desirable that the carbon dioxide should not be liberated. For example, in the Sevier Valley, Utah, the alkali exists very largely in the form of bicarbonate of soda, which is much less harmful than the sodium carbonate which would be formed if the carbon dioxide present were allowed to escape freely.

SOIL MOISTURE INVESTIGATIONS.

The investigations on the capillary movement of water in dry and moist soils, begun during a previous year, have been extended, and the subject has been more fully developed. It has been found that the extent of capillary action in the soil under field conditions is not represented by the capillary rise of water in the air-dried soil, the method which has heretofore been employed. A method has, however, been devised through which the extent of capillary action in moist soils may be determined, and which it is believed is fairly representative of field conditions. This method also permits investigation of the rate at which water is supplied by capillary action through soil columns of various heights, a subject which is of fundamental importance, since all plants are to some extent dependent upon the capillary action for their water supply.

The investigations of the influence of dissolved salts on the capillary rise of soil moisture have also been continued. This subject has an important bearing upon the treatment of alkali lands. It was found that dilute solutions of neutral salts have practically no influence upon the capillary action, while concentrated solutions of all salts materially diminish the extent of the capillary movement. In the case of the alkaline salts, however, the capillary rise is considerably greater than for neutral salts of the same concentration. A detailed description of these results and their practical bearing is now in course of publication.

RELATION BETWEEN CARBONATES AND BICARBONATES IN ALKALI SOILS.

In continuation of the work on carbon dioxide an investigation has been made in connection with the chemical laboratory of this Division of the equilibrium between carbonates and bicarbonates in solutions of various concentrations and temperatures. The economic bearing of this investigation and the results obtained will be further referred to.

SPECIAL APPARATUS.

The special electrical apparatus devised in the physical laboratory for the investigation of soluble salt content of soils is now being extensively used by the field parties in the alkali investigations in the West. A filter has recently been devised for the removal of suspended clay from soil solutions, and has been found very useful in the field and laboratory. Perfectly clear soil solutions can be quickly obtained by its use, and chemical determinations in the field which were formerly difficult or impossible on account of the suspended clay can now be readily carried on.

MECHANICAL SOIL ANALYSIS.

During the past year 640 complete mechanical soil analyses have been made. These analyses have been restricted almost entirely to the examination of the various soil types established by the field parties, serving as a check upon the field classification and as a matter of information regarding the mechanical texture of the soils. The method of analysis, which involves the use of a centrifugal apparatus to separate the sand and clay, is much more rapid than the methods formerly employed, and two men can now readily make 50 complete analyses a week.

USE OF PHOTOGRAPHY.

Photography has become a valuable adjunct to the work of the Division, both in illustrating the characteristic features of the areas surveyed and in the preparation of the base maps for field use. The topographic sheets of the Geological Survey are used as base maps whenever available, but frequently we are dependent upon county atlases or other maps. These maps naturally vary greatly as to scale, but can be readily and quickly reduced by means of photography to the uniform scale of 1 inch to the mile, used in the work of the Division. For this purpose a modest photographic equipment for enlarging and reducing has been installed. Photographic paper used is also prepared at small cost in the laboratory, and the preparation of the base maps can now be rapidly and economically carried on.

FUTURE WORK.

It is proposed to investigate as thoroughly as possible during the coming year the apparent forces between soil particles, and the flocculation of clay. The importance of such a research is at once evident, when we consider that the unproductiveness of many soils is due primarily to the compact, unyielding mass resulting from the apparent forces between soil grains. A satisfactory method of bringing soils of this kind into a more friable condition, so essential to proper plant development, would be of untold value to our agricultural interests, and is worthy of the most earnest research.

It is also proposed to investigate during the coming year the diffusion of salts in the capillary spaces of soils. This has never been investigated in a manner applicable to our work, and the information is necessary before proceeding further with the study of the distribution of soluble salts in the soil formation of hardpan, and many kindred problems.

LABORATORY OF SOIL CHEMISTRY.

The work of the past year has involved the examination of a large number of soils, irrigation waters, rocks, minerals, and similar materials, sent in by the field parties, together with furnishing data of a miscellaneous character to others. In addition to this routine work, a number of investigations have been carried on which have yielded results of considerable economic importance, as well as of scientific interest.

The work on the chemical composition of type soils from Maryland, which had been undertaken some time before under the joint auspices of the Maryland experiment station and this Department, was brought to a conclusion. The results have been published in Bulletin No. 70 of the station. The principal needs of the soils with respect to fertilizers were so clearly brought out as to justify suggestions with a considerable degree of confidence.

The study of the effect of certain soluble salts which find application as mineral fertilizers on type soils has been carried on and results of interest have been obtained showing that the solubility of the mineral components of the soil are much affected thereby, generally in the direction of an increased solubility. The importance of this work for a rational control of the fertilizing problem is thoroughly appreciated, but it is not advisable to give details of the work at the present stage of the investigation.

CHEMICAL PROPERTIES OF THE MOISTURE IN SOILS.

Further attention has been given to the subject of soil solutions, or the nature and composition of the material dissolved in the ground waters which are present in all arable soils. The importance of investigations along this line for making clear the chemical and chemico-physical processes taking place in the soil, the relation of the plant to its mineral nutrients, and the development of rational methods of fertilizing, is becoming more evident with the progress of the work. The nature and function of soil solutions has been discussed in a publication from the Division during the year in which the rôle of water, iron, calcium, carbon dioxide, hydrous silicates, organic matter, etc., is carefully considered, together with adsorption by soils, soil acidity, and related phenomena.

THE EFFECT OF A SALT UPON THE SOLUBILITY OF ANOTHER SALT.

The effect of readily soluble salts upon the less soluble mineral components of the soil is obviously of the first importance in the study of alkali and in the use of mineral fertilizers. Experience has shown that lime sulphate, in the form of gypsum, and lime carbonate are probably the most important of the slightly soluble components of the soil in arid regions. Therefore the first work has been done upon these substances.

The solubility of gypsum has been carefully studied in the presence of sodium chloride, magnesium chloride, calcium chloride, and sodium sulphate, and in the presence of sodium chloride with calcium carbonate simultaneously. The effect of these other substances upon the amount of gypsum taken up was found to be very great, the solubility in certain cases being increased nearly fourfold.

In an analogous manner the solubility of calcium carbonate and magnesium has been studied in solutions of more soluble salts, due attention being given to the modifying action of the amount of carbon dioxide in the air.

That the results of these investigations will have a technical value other than for agricultural studies seems assured, and communications have been received from some manufacturing concerns and chemical engineers relative thereto.

THE RELATION BETWEEN CARBONATES AND BICARBONATES IN ALKALI SOILS.

In cooperation with the physical laboratory of the Division a very important investigation was made of the equilibrium between carbonates and bicarbonates in water solutions. For instance, in the valley of the Sevier River, in Utah, where the soils are naturally provided with a fairly good underdrainage and the total amount of the alkali in the soil is low, the proportion of bicarbonates to carbonates found in the soil is large. Seepage waters from the soil, when exposed to the air, either evaporating in ponds or aerated in the rapids of the river, show increasing amounts of normal carbonate as the aeration continues up to certain definite and invariable limits for constant condition. In other areas containing black alkali, as about Fresno, Cal., where the total amount of alkali in the soil is relatively larger, the proportion of normal carbonates to bicarbonates is correspondingly greater, and the former preponderate to such an extent as often to be the most prominent characteristic of these soils. Since it has been made evident that bicarbonates are much less harmful to vegetation than normal carbonates, the economic importance of any work which will throw light upon the subject and aid in its control is self-evident. This work is of value also in connection with the view, for which there seems to be some ground, that basic elements that serve as plant food in the soil solutions of humid regions are present mainly in the form of bicarbonates.

It was shown that even in contact with air containing but a small proportion of carbon dioxide, and all the more in contact with the soil atmosphere, which normally contains a much larger proportion of carbon dioxide, a solution of a normal (caustic) carbonate must also contain some of the corresponding bicarbonate. On the other hand, it was shown that a solution of a bicarbonate under all conditions with which one meets in nature must necessarily contain a definite proportion of the normal carbonate. It was shown that in the case of the lime salts, under the conditions in which natural waters occur, the

proportion of normal carbonate to bicarbonate is so small that the solutions for most practical purposes may be considered as solutions of the bicarbonate alone. But for the salts of magnesium, potassium, and sodium this is far from being the case. In all cases, the proportion of normal carbonate to bicarbonate increases with the temperature and with the concentration. These results are of great significance in explaining the conditions observed in various areas of the arid regions containing soluble carbonates, and which at first appeared hopelessly anomalous. It is believed that the results will have value not only in soil studies, geological investigations, etc., but also in certain technical operations involving the preparation and handling of alkaline carbonates.

CLASSIFICATION OF ALKALI SOILS.

The present classification of alkali soils into those containing white alkali and black alkali, each of which presents an infinite number of problems, is not in keeping with the advance in our knowledge concerning such soils. As a result of the investigations of this Division, a new classification has been proposed, as it indicates that the vast array of problems which the alkali soils have apparently presented hitherto can be grouped into a very few general classes.

It has been shown that alkali does occur in the soils of humid areas under certain conditions, and that these conditions are not unusual. Indeed, it seems probable that the formation of temporary alkali in soils of the humid regions is much more common than generally supposed, and this may account for certain phenomena of plant disease.

ALKALI VEGETATION AND SOILS.

The relation of the natural vegetation of a soil to the inherent characteristics of the soil itself, while a matter of great importance and worthy of the closest attention everywhere, is especially so in alkaline areas. A study of the effect of the growth of certain plants in forming soluble carbonates, better known as black alkali, in soils where this substance had not previously existed, has been continued during the past year. It has been shown that this factor must be considered in the introduction of such plants for forage purposes, as the final condition of the soil may be made worse by the formation of the very harmful black alkali from the white alkali originally present.

A study has been made of certain native plants which have been found to grow on soils containing excessive amounts of sodium carbonate or black alkali, in which no other vegetation will grow. It was found that these particular plants were able to excrete soluble organic acids on their leaves and stems, and these acids are sufficiently strong to decompose carbonates, and thus form neutral salts, less injurious to vegetation. It seems probable that the plants protect themselves from the caustic action of the carbonates by the formation of these acids. The further study of this subject and the possible economic value of these plants is in the province of plant physiology.

The amount of soluble salts which may be present in a soil and yet not prohibit growth has been found with a close degree of accuracy for the various areas in which the field parties have worked. But as the character of the alkali varies in different areas, quite an extended investigation was carried on, in cooperation with the Division of Vegetable Physiology and Pathology, to determine the toxic limit (or

the proportions and amounts which may exist without prohibiting plant growth) of each salt or mixture of salts commonly found in alkali soils or used as fertilizers. The influence of various concentrations of these salts or salt mixtures was noted upon seedlings of alfalfa, white lupine, and wheat. It was found that the limits for these various salts differ greatly. The idea commonly held that the action of these salts is a physico-chemical one alone, and dependent upon the "osmotic pressure" which they exert in the soil solutions and a consequent mechanical rupture of the plant tissues, has been disproved. It was shown that the effect of one salt in raising the toxic limit of another is often very great. The importance of the lime salts in this connection was shown to be enormous, the limit for magnesium chlorides being raised many times in the presence of an excess of lime sulphate. These investigations open up lines of work for the physiologist and for the scientific study of fertilizer applications.

CHEMICAL METHODS FOR USE BY FIELD PARTIES.

The field method for the determination of carbonates, bicarbonates, and chlorides has been further studied in the laboratory, for the purpose of obviating certain mechanical difficulties which had arisen in its use, and also to extend its application to other similar determinations. It is believed that it is now in very satisfactory shape for either field or laboratory use.

COOPERATION WITH STATE INSTITUTIONS.

As heretofore, this Division has attempted to secure the fullest possible cooperation with the State experiment stations, boards of agriculture, and geological surveys. Such cooperation has been particularly close and satisfactory and mutually beneficial with the Maryland Geological Survey, Maryland Agricultural Experiment Station, the North Carolina Department of Agriculture, the Utah Agricultural Experiment Station, and the Arizona Agricultural Experiment Station. Other institutions have helped in various ways in the preparation of plans and the securing of base maps.

PUBLICATION OF THE REPORTS AND MAPS.

The Fifty-sixth Congress, second session, provided by joint resolution, approved February 23, 1901, for the publication annually of a "Report of the field operations of the Division of Soils." In accordance with this, the report of the field work for 1900 was prepared and transmitted to the Public Printer about March 1, 1901. Under the contract let by him for the lithographic work on the maps, these were to be delivered not later than September 1; but on July 4 the lithographic establishment where they were being prepared was destroyed by fire. Fortunately, the work had progressed so far that records of all the work were preserved; nevertheless, the publication of the report will necessarily be delayed, and it can hardly appear before the end of the calendar year.

As the work of the Bureau extends it is doubtful if the publication of all the results of the field operations in one volume will be either feasible or economical; but this is a matter which can hardly be determined at this time.

EXPENSES OF THE WORK DURING THE FISCAL YEAR.

Having said so much of the results that have been attained in the several lines, it will be of interest to report upon the cost of the work, to show that the money appropriated was wisely and economically expended, and that the results could only have been secured by an excellent organization and by efficient and constant work on the part of all the employees of the Division.

The following statement, taken from the financial books of the Division, shows the distribution of the expenditures among the several offices:

Statement of expenditures, year ended June 30, 1901.

Administrative expenses:		
Salaries	\$8,538.59	
Supplies	511.63	
Rent	660.00	
Gas	109.50	
Electric current	107.99	
Express and freight	18.19	
Telegrams	22.58	
Engine repairs	113.20	
		\$10,081.68
Laboratories:		
Salaries	5,345.70	
Supplies	583.75	
		5,929.45
Tobacco investigations:		
Salaries	4,579.99	
Supplies	12.00	
Traveling expenses	1,017.65	
		5,609.64
Soil survey, Eastern division:		
Salaries	5,776.45	
Supplies	169.85	
Traveling expenses	2,882.58	
		8,828.88
Soil survey, Western division:		
Salaries	5,430.93	
Supplies	264.45	
Traveling expenses	3,697.07	
		9,392.45
		39,842.10
RECAPITULATION.		
		Per cent.
Administrative expenses	\$10,081.68	25.3
Laboratories	5,929.45	14.9
Tobacco investigations	5,609.64	14
Eastern soil survey	8,828.88	22.2
Western soil survey	9,392.45	23.6
	39,842.10	100

It will be seen from this statement that the expenses of the administrative office, including the salary of the chief and of all the clerks, together with the incidental expenses, amounted to about 25 per cent of the whole appropriation; the laboratories each cost something less than \$6,000, or about 15 per cent; the tobacco investigations about \$5,000, or 14 per cent, while the soil-survey work took about 46 per cent of the appropriation. In all, upward of 60 per cent of the appropriation was expended for the tobacco investigations and the soil survey, carried on almost exclusively in the field and in a number of States. The amount of work done and the results accomplished, it

is believed, fully justify the expenditure of the money, as well as the reorganization into a bureau and the increase in the appropriation for the work of the new Bureau of Soils.

ADDITIONAL ROOM ACQUIRED.

In my last report I called attention to the impossibility of providing for the work of the Division of Soils without additional room. Congress has accordingly increased the limit for the rent of buildings, and arrangements have been made for the removal of the Division of Vegetable Physiology and Pathology from the adjoining offices, which will then be occupied by the Bureau. While this will provide room for our immediate needs, it has seemed necessary to ask for a further increase in the limit to be paid for rent, as it is likely that larger quarters will be required in the near future.

CLERICAL WORK.

The publications of the Division during the fiscal year consisted of two reports, three bulletins, two Yearbook articles, and one miscellaneous paper, aggregating in all 279 pages. The "Report on the field operations of the Division of Soils, 1900" (473 pages), was completed for the press, but the issue, as already explained, has been delayed. This, added to the above, will bring the total up to 752 pages, against 558 pages last year. Correspondence has largely increased, and about 3,000 replies to letters were sent out. The soil collection was increased by 765 samples during the year, making a total of 5,523 samples, which have all been catalogued; 640 mechanical and 150 chemical analyses were made during the year, and the results catalogued in a convenient form for reference; 463 photographic negatives were added to the collection, making a total of 831, illustrating the soil conditions and problems, all of them having been catalogued. A small library of soil literature maintained by the Division has received 281 volumes and pamphlets during the year, which have been classified and catalogued. The library now contains 1,921 books pertaining to soils. The Division now has 2,652 maps of various kinds, which have been catalogued, a part of them as base maps for possible use in the extension of the soil survey, and part of them as records of soil work in this and other countries.

CONCLUSION.

In presenting this, the last report of the Division of Soils, together with some of the plans for the new Bureau of Soils, it will be allowable to point with just pride to the phenomenal growth of the work of soil investigations from its inception six years ago as a subordinate division of the Weather Bureau into a bureau of itself, well organized and equipped to carry on the larger sphere of work made possible by the increased appropriation; also to contemplate with considerable satisfaction the results accomplished, especially in this last year, with a very moderate expenditure of the public funds. The work has received a very general and cordial appreciation, and has met the supreme test of the Department, practical utility and material benefit to the tiller of the soil. Nor can I conclude without warm words of commendation for my principal assistants and their subordinates and an acknowledgment of the zeal and energy with which each one has contributed to the success of the year's work.

REPORT OF THE ENTOMOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., August 10, 1901.

SIR: I submit herewith an executive report covering operations in the Division of Entomology for the fiscal year ended June 30, 1901, dividing it, in accordance with the directions contained in your circular letter of July 8, into the following sections:

(1) A brief review of the operations carried on during the fiscal year 1901.

(2) An outline of the plans proposed for the work of this Division for the fiscal year 1902, under appropriations already made for that year.

(3) Suggestions as to work recommended for the fiscal year ending June 30, 1903, for use in preparing estimates.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The amount appropriated by Congress for entomological investigations (aside from salaries appropriated for by the statutory roll) was \$22,500. Out of this amount there was expended the sum of \$22,206.76, leaving an unexpended balance covered into the Treasury of \$293.24. The main items of expense may be grouped as follows: Salaries of investigators and other employees, stationed for the most part in Washington, D. C., \$16,384.59; salaries of field agents, \$913; miscellaneous office supplies and expenses, \$2,327.64; traveling expenses, \$2,184.33; illustrations, \$397.20. Of the salaries for employees, the amount expended for expert scientific assistants has been \$12,144.59, and for clerical and other assistants, \$4,240.

The work of the Division may be classified, as in former years, under the following heads:

(a) Investigations upon specific injurious insects or groups of insects.

(b) Experimental work with remedies.

(c) Determination of specimens sent in by the entomologists of the State experiment stations and by other workers.

(d) General investigations of the life histories of injurious insects.

(e) Work on the geographical distribution of the injurious insects of the United States.

(f) Bibliographic work.

(g) Preparation of circulars of information.

(h) Correspondence.

(i) Work upon the exhibit of insects for the Pan-American Exposition.

(j) Work in apiculture.

Briefly summarized, the work of the Division under each of these heads has been as follows:

(a) INVESTIGATIONS UPON SPECIFIC INJURIOUS INSECTS OR GROUPS OF INSECTS.

WORK ON INSECTS FROM ABROAD.

The most striking result in this branch of work which has been achieved has been referred to in its different stages of progress in the last two reports. This is the introduction and establishment of the fig-fertilizing insect (*Blaslophaga grossorum*) from Algeria into California, where it was practically used for the fertilization of the large orchard of Smyrna figs at Fresno. An assistant was sent to Fresno in the spring of 1900, and remained there throughout the season, making observations which completely cleared up the life history of the insect and resulted in the ascertaining of important facts previously unknown, although in southern Europe the insect had been known and studied for very many years.

This assistant also took active part in the practical work of handling the insect and fertilizing the Smyrna fig crop. The results exceeded the most sanguine expectations. A very large crop of Smyrna figs was raised, dried, and placed upon the market in the autumn of 1900. Tests made by chemists and by fruit experts showed that not only were these California-raised Smyrna figs fully equal to the imported product, but that they contained a larger percentage of sugar. In the opinion of those well qualified to judge, they possessed a superior flavor and were cleaner and more attractive in general appearance.

The experience gained during the summer and autumn of 1900 enabled the work, during the spring and early summer of 1901, to be carried on to much better advantage. The insect hibernated successfully, in many instances without artificial shelter over the trees, and the prospects for the crop of the season of 1901 at Fresno indicate that the output will be more than four times as great as that of the summer of 1900, and last year's experience in preparation for the market will improve the quality of the product.

The fertilizing insect has been thoroughly established at Niles, Cal., where observations have been carried on throughout the whole fiscal year by agents of the Division, and it has also been established at several other points. The Division holds itself in readiness to furnish a supply of the insects to any fig grower after he has succeeded in raising to the bearing stage caprifig trees and Smyrna fig trees.

Mr. George C. Roeding, the proprietor of the large orchard at Fresno, went to Smyrna in the spring of 1901 for the purpose of studying the methods in use in that country, under commission from this Department. A full account of the work done and the results obtained down to the close of the calendar year 1900 was published in an article by the Entomologist in the Yearbook of the Department for that year, and since that publication, continued work has been done, the California operations having been carefully followed. It is perfectly safe to state at this time that a new horticultural industry of great future value to the country has been firmly established.

In the last report mention was made of the introduction from South Africa of an important and desirable parasite known as *Scutellista cyanea*, which attacks the black scale, a destructive insect in the olive and orange groves of California. These specimens were secured through the courtesy of Mr. C. P. Lounsbury, the entomologist of Cape Colony. They were received June 8, 1900, and were at once expressed to Santa Clara County, Cal., where Mr. E. M. Ehrhorn was prepared to care for them. On August 16 a new generation made its appearance in California, sixty days from the time of the arrival of the survivors of the journey from Africa. These were reared on a covered oleander plant, and were divided and placed upon several other covered plants infested with the scale. They bred up to the appearance of the cold weather. Before the close of the season colonies were placed in several orchards infested with black scale outdoors, while other colonies were retained under cover. Up to February 24 nothing further was noticed in the way of living specimens, nor was it seen during the following spring and early summer months. It is a very small insect, however, and it may exist at large in the olive orchards. Scale-infested branches have been collected at intervals and placed in breeding jars, but nothing has been bred from them. Further introductions will be made, and establishments will be tried at points farther south than San Jose.

There can be no doubt that this parasite is a very effective enemy of the black scale in South Africa, and, in fact, it has been rather difficult to find enough scales to propagate the parasites for shipment to this country.

Strong efforts were made during the year to import, in living condition, European enemies of the Gipsy moth. The cessation of the extermination work, which had been carried on for several years against this insect by the State of Massachusetts, created, for the first time, a favorable opportunity for these attempts. The Division has placed itself in correspondence with several European entomologists, and two consignments of European predatory beetles (*Calosoma sycophanta* and *C. inquisitor*) have been received through the kindness of Dr. Paul Marchal, of Paris, and Captain Xamheu, of Pyrenées Orientales; but although the greatest care has been taken in packing, not one living specimen has as yet reached Washington. The attempt is being continued, and, with little doubt, some successful method of introducing these beneficial species will be ascertained. This is the first attempt which has been made to introduce insects of this family (*Carabidae*) across the ocean, and on account of the fact that they are great cannibals and very active insects, the introduction is especially difficult of accomplishment. Meantime, the Gipsy moth is spreading far beyond its old boundaries in New England, having reached Providence, R. I., the present year; and another important insect, the brown-tailed moth, which will also be attacked by these European predatory species, has become so numerous in eastern New England as to attract very general attention. There is, therefore, every reason for active efforts to bring about the establishment of their European natural enemies.

Bearing upon international work, although not strictly coming under this head, the introduction of the South African locust fungus was briefly referred to in the last report. During the winter of 1901 additional culture tubes of this fungus, which was stated to have been so successful in destroying the South African grasshoppers or locusts, were received through the kindness of Dr. Eddington,

of the bacteriological laboratory at Pietermaritzburg, Natal, and the veterinary branch of the Department of Agriculture at Cape Town, and by cooperation with the bacteriological laboratory of the Bureau of Animal Industry of this Department the Division was able to secure a large number of subcultures, which, during the early summer of 1901, were distributed to many correspondents in the Western States in localities where grasshoppers appeared in enormous numbers. In all, something like 190 tubes were distributed, with full directions for their use, and with directions for preparing subcultures in the field. Owing to the extreme drought, the majority of the experiments were unsuccessful. One locality in Colorado reports great success, three localities in Nebraska report excellent results, and one in New Mexico and one in Texas also report a reasonable amount (more or less) of success. At the time of this writing reports are still coming in, and the subject will be treated in detail in the Yearbook of the Department for 1901.

WORK ON GARDEN AND GREENHOUSE INSECTS.

Investigations begun in previous years on insects of these classes have been continued. A successful investigation of two very important species—the fall army worm and the variegated cutworm—has been completed, and the results will be published in Bulletin No. 29 (new series).

An important publication has been prepared and issued on the insects injurious to the violet, rose, and other ornamental plants, a subject which had never before received competent and specific consideration from economic entomologists.

A technical bulletin (No. 8, technical series) was published during the year, which treats monographically of the red spiders and white flies of the United States, two groups of insects abundant and injurious in greenhouses and in the field.

WORK ON SCALE INSECTS

Extensive work on these very important insects, which have gained such prominence in the horticultural world since the advent of the San Jose scale into the Eastern United States, has been carried on. This work has been largely of a systematic kind, although much experimental work with remedies has also been conducted. Scale insects have been sent to the office from all parts of the country, in fact from all parts of the world, for examination, and a monographic work upon the most destructive species is in preparation. Circular No. 42 (second series), on how to control the San Jose scale, has been published as the result of the remedial experimental work. Owing to the fact that fruit exporters of this country have been greatly hampered by the regulations passed by various foreign Governments alarmed at the prospect of introducing the San Jose scale, there has been a demand from these people for condensed and plain information as to the exact effect of these foreign regulations. There was therefore prepared and published during the year a circular entitled "Regulations of foreign Governments regarding importation of American plants, trees, and fruits," which has been distributed as widely as possible among American exporters of these products.

Ever since the appearance of the San Jose scale in the United States the question of its original home has been a mooted one; and since none of the parasitic and predatory insects of this country seem to be very efficient in destroying this scale, it has become an important

point to decide, if possible, the question of the original home of this scale, since this original home once found, it is quite fair to suppose that there also may be found efficient parasites. The evidence accumulating during the past two or three years has pointed quite strongly toward Japan, and in the spring of 1901 a competent assistant, Mr. C. L. Marlatt, was sent to Japan for the purpose of studying this question upon the ground. Unexpectedly to most entomologists in this country, although not to the writer and to the investigator, it has been quite definitely ascertained that the San Jose scale is not indigenous to Japan, but that, quite to the contrary, it was introduced into that country from the United States upon fruit stock. Nevertheless, an allied scale, known in this country as the West Indian peach scale, has been found to be indigenous in Japan, and to possess efficient natural enemies which also prey upon the San Jose scale. An attempt is being made to introduce these natural enemies into this country, and further efforts will be made, by continuing the journey, to find in oriental regions the true original home of the San Jose scale.

INSECTS AS CARRIERS OF DISEASES OF HUMAN BEINGS.

This subject of investigation, while, perhaps, it may be considered only indirectly agricultural, comes distinctly within the province of this Division, since it is the only governmental institution concerned with work in economic entomology; and, also, anything which relates to the health and well-being of agricultural classes is agricultural. Aside from their disease-bearing relation, mosquitoes are in part responsible for the nonavailability of large tracts of land of great agricultural possibilities.

As a consequence, much attention has been paid to the general subject of mosquitoes, especially in their relation to disease and in the search for the most efficient remedial measures.

In August, 1900, a comprehensive bulletin was published dealing with North American mosquitoes, which has been used extensively by physicians in different parts of the country as a guide in distinguishing all those which carry malaria, as well as those which have probably no disease relation, and in learning about the breeding places of the former. It also dealt largely with the subject of remedies. Investigations of the office on the subject of mosquitoes were carried on throughout the year. Advice was given by correspondence to many communities and organizations of individuals engaged in anti-mosquito work, and in cooperation with the Division of Soils some work was done looking toward the reclamation of brackish marshes, which are great breeding places of mosquitoes.

There was completed during the year an investigation of the insects breeding in or attracted to human excreta, for the purpose of determining what flies may be safely said to take part in the dissemination of typhoid fever. These results have been published in full, and will be summarized in Bulletin No. 30 (new series) of the Division of Entomology, and a short article on the general subject of insects as carriers of disease will be published in the Yearbook for 1901.

WORK UPON INSECTS DAMAGING FORESTS.

The investigation undertaken for the Division by Dr. A. D. Hopkins in the spring of 1901 upon the insects injuring forests in northern New England was completed, and a bulletin describing the results is now in press, and will appear as Bulletin No. 28 (new series).

WORK ON THE CODLING MOTH IN THE NORTHWEST.

Apple culture having become very important in the States of Idaho, Washington, and Oregon, and the codling moth having been accidentally introduced into those States, it has become apparent in the last few years that the remedial measures which have been so successful against this insect farther east are for some unexplained reason by no means so successful in the far Northwest. Therefore, upon the receipt of petitions from fruit growers from all three of the States mentioned, an investigation was begun in cooperation with the official entomologists of the respective State agricultural experiment stations. An agent of the Division spent the summer of 1900 in Idaho, ascertained many important facts, and outlined a course of procedure which if carefully followed will alleviate present conditions. This report will be published in Bulletin No. 30 (new series) of this Division. The same agent took the field again in the early summer of 1901, and the investigation will be followed throughout the season.

WORK ON THE MEXICAN COTTON-BOLL WEEVIL.

In the spring of 1898 the work which had been done by the Division in 1896 and 1897 against this insect was stopped. The State legislature of Texas made an appropriation providing for a State entomologist, and since a competent man was appointed and furnished with means for investigation, it was considered desirable to devote the funds of the Division to investigations not otherwise provided for. During the winter of 1900-1901, however, it appeared from the reports of the Texas entomologist, Prof. F. W. Mally, that the weevil had spread widely beyond its original range and beyond the limits to which it was supposed it might be confined. The problem, therefore, became one of broad interest, since the insect had already reached within 100 miles of the Louisiana border, and had doubled its northward range from the mouth of the Rio Grande. Other cotton States are therefore threatened. The Texas authorities appealed to the Division for cooperation, and Congress made a special appropriation for a thorough investigation of this particular insect by this office. This appropriation did not become available until the beginning of the fiscal year 1901-1902, but the emergency seemed so great that an especially qualified expert was sent into the field in March, 1901, his salary and expenses being paid from the general fund of the Division, and he worked conscientiously and successfully for the remainder of the fiscal year. The investigation will be continued throughout the next fiscal year.

WORK ON INSECTS INJURING CITRUS TREES AND FRUITS.

An assistant was stationed in southern California throughout the summer of 1900, as mentioned in the last report, and conducted an extensive series of observations upon insects injurious to the orange, the lemon, and other citrus fruits in that part of the country. His work included not only studies of the insects, but experiments with remedies against the injurious species. The results of this investigation are included in an article entitled "The scale insect and mite enemies of citrus trees" in the Yearbook of the Department for 1900.

OTHER INVESTIGATIONS.

The work against injurious grasshoppers in the State of Mississippi, mentioned in the last report, was continued through the summer of

1900 by an agent of the Division, and the results will be published in Bulletin No. 30 (new series). As a result, probably mainly of the work done, but undoubtedly also of the work of natural enemies and changed weather conditions, no complaint has been made the present summer of the work of grasshoppers in this locality. Other specific work of this character, but of less importance, has been carried on in many directions, and will probably achieve results worthy of special mention at a later date.

(b) EXPERIMENTAL WORK WITH REMEDIES.

The work outlined in the last report has been continued. Many substances have been experimented with. A number of disputed claims as to insecticidal values have been set at rest. The lime, sulphur, and salt wash, so successfully used in California against scale insects on deciduous trees, but which had previously been found unsuccessful in the East, has been again experimented with under different conditions, and has been found to be very successful wherever the weather conditions happened to be very favorable, duplicating in a measure the conditions on the Pacific coast. The general subject of insecticidal measures, after extensive experimentation, has been covered in Farmers' Bulletin No. 127, issued February 6, 1901, and for which there has been great call from agriculturists and horticulturists. It is a detailed treatise of the more important insecticides, with directions for their preparation and use. The results of a large series of experimental tests will be published in Bulletin No. 30 (new series) of the Division.

Experimental work with fumigants has also been carried on, and some important experiments have been made in the way of fumigating bake shops and granaries against grain insects, and tobacco establishments against the tobacco beetle, or "cigarette beetle," as it is sometimes called. A lengthy series of insecticidal operations was carried on by the first assistant in southern California, which were reported upon in the Yearbook of the Department for 1900.

(c) DETERMINATION OF SPECIMENS SENT IN.

As reported in previous years, the different experts in the Division have been obliged to devote much of their time to the naming of specimens for experiment station entomologists and others who have not access to large collections, either of specimens or of books. The fact that the Division is obliged to name specimens for entomologists of the experiment stations is by no means derogatory to these station officials, since the field of entomology is so great that one man can hardly have expert knowledge of the highest character of more than one of the large number of groups of insects. The office force of the Division, however, is composed of a number of such experts, and entomologists working single-handed are practically obliged to consult them. This work, as has previously been pointed out, although excessive, makes no showing in the practical output of the Division. It is indirectly, however, of much practical value as facilitating the work of station entomologists.

(d) GENERAL INVESTIGATIONS OF THE LIFE HISTORIES OF INJURIOUS INSECTS.

During the fiscal year life-history notes were made upon 154 species of insects which had not before been studied in the insectary. The catalogue number of the biological series so studied reached 9,441 on

June 30, 1901. This means that in the divisional work, from 1881 to date, 9,441 species of insects have been studied in confinement in an effort to learn their full life histories in order to judge of their economic importance, and if injurious to determine the best point of attack.

(*e*) WORK ON THE GEOGRAPHICAL DISTRIBUTION OF THE INJURIOUS INSECTS OF THE UNITED STATES.

This work has been carried on during the year. A number of maps have been brought down to date and are already found to be most useful in the work of the Division. It is hoped that before long maps of the distribution of the most prominent injurious species will be ready for publication, and so be available to other working entomologists.

(*f*) BIBLIOGRAPHIC WORK.

Part VII of the "Bibliography of the more important contributions to American economic entomology" was published in November, 1900. It brings the bibliography down to January 1, 1900, and completes to that date a work which is unique and of the greatest value to all persons writing upon the subject of injurious insects.

There was also published in this line, as Bulletin No. 24 (new series) of the Division, a list of works on North American entomology, compiled for the use of students and other workers, and which includes such titles as those of synopses, catalogues, and lists, arranged under the different groups of insects, thus enabling the worker who wishes to determine species to learn readily just what works to consult.

(*g*) PREPARATION OF CIRCULARS OF INFORMATION.

Many of these useful circulars, which have been of the greatest assistance in the way of reducing the bulk of the correspondence by presenting in concise form the information most frequently asked for by persons seeking remedies for injurious insects, have been reprinted, and three additional numbers have been published during the year.

(*h*) CORRESPONDENCE.

The correspondence of the office has been greater than ever before in the history of the Division. About 8,500 letters were written during the year in answer to inquiries regarding injurious insects, and many others were answered by printed or mimeographed circulars.

(*i*) EXHIBIT OF INSECTS AT THE PAN-AMERICAN EXPOSITION.

Although the space allotted to the Division in the Government building was very small, an instructive exhibit was sent on, comprising two parts. The first class, insects injurious to agricultural and horticultural industries in the Northeast, was contained in 28 trays, and comprised specimens of the insects and their work, with enlarged illustrations of those which are too small to be easily made out by the naked eye. Those of the second class were contained in 24 trays, and illustrated very completely the insects which damage forest trees in Northern United States, showing not only the insects themselves, but excellent examples of their work in wood and under bark, as well as on other portions of the trees.

It is the experience of the Entomologist, and he knows by conversa-

tion with persons in charge of other branches of scientific work under the Government, that these annual expositions are and will continue to be serious hindrances to the specific work appropriated for by Congress, so long as special funds for the preparation of exhibits are not sufficiently large to enable the employment of additional specialists for exposition purposes alone. The work of this office and of other offices is interrupted every year by the necessity of preparing such exhibits, and time is spent for this purpose which is intended by the Government, under direction of Congress, for entirely different purposes.

(j) WORK IN APICULTURE.

Further comparative tests have been made of Carniolan, Italian, and Cyprian bees, with crosses of the first and last. Practical tests of methods employed in rearing queen bees have been made, and original devices facilitating production of queens have been developed. Successful experiments in the sending of queen bees by mail have been made, and additional data concerning honey-producing plants have been collected. The correspondence in this branch of the work has been constant and extensive.

PROPOSED WORK FOR THE FISCAL YEAR 1902.

Work for the fiscal year 1902, which at the date of this writing is already well under way, will be carried on in the same directions as the work during the past fiscal year. Investigation of the codling moth in the Northwest, as authorized by Congress, will be continued. The work against the Mexican cotton-boll weevil in Texas will be carried on through the whole year, one or more agents being employed specially for the purpose. The South African grasshopper fungus will receive a severe practical test, and the native diseases of Western species will also be studied. The year promises to be one of very considerable injury from different species of grasshoppers, and a study of the conditions under which these abnormally numerous local swarms have developed will be made by an expert. The search for the original home and natural enemies of the San Jose scale will be continued in Oriental regions by one of the assistants. An investigation will be made, at the request of the Cuban government, into damage done by insects to the cocoa palm in the province of Santiago, and an assistant has already been sent to the island for that purpose. Extensive experimental work with remedies will be continued, and the general investigations of insects injurious to garden and field crops and to shade and forest trees will also be continued. The extreme interest which is being taken in the mosquito question by many communities indicates that much advisory work must be done by this office, and experts will be sent from time to time to such communities to point out the best methods of procedure, while it is hoped that the Bureau of Soils will continue to cooperate in the work of reclaiming mosquito-breeding swamp tracts.

In apiculture, owing to the fact that Congress has for the first time made a specific appropriation for this work, the Division will undertake the importation and distribution of a limited number of Italian, Carniolan, and Cyprian queen bees, also the breeding of select queens of these races and various crosses between them, for distribution and comparative tests in different parts of the country, especially by the State agricultural experiment stations. The study of honey-producing plants will be continued, and maps will be prepared showing the distribution of the most important. Finally, practical tests of various

original devices connected with queen rearing will be made, and the results will be published. It is proposed to make a study of certain features of the bee-keeping industry in Florida, Texas, New Mexico, Arizona, and southern California, and experiments will be carried on to develop a safe and cheap method of wintering surplus queens. An effort will also be made to collect information regarding the honey resources and other conditions affecting bee keeping in Porto Rico, Hawaii, Alaska, and the Philippines.

SUGGESTIONS AS TO ESTIMATES FOR THE YEAR 1903.

I recommend that all of the appropriations made for the year 1902 be continued for the year 1903, with an increase in one item only and the addition of another item. The investigation of the Mexican cotton-boll weevil is one of such potential importance to the cotton-growing industry that it is obvious that no effort should be spared to find a practical and cheap means of fighting this destructive insect. The work of the summer of 1901 and of the spring of 1902 will not settle the question. Many points will still remain to be set at rest. Therefore the reappropriation of \$3,500 for this investigation is urged. The same may be said of the appropriation of \$1,000 for the investigation of the codling moth in the Northwest, with a view of ascertaining the best remedial measures to be adopted in that section of the country.

With apiculture, it seems very desirable that the appropriation should be increased. The \$2,000 appropriated for 1902 is sufficient to pay a small salary to one expert, leaving a very small amount for the expenses of the investigation work. The bee industry is such a large one in this country, and its possibilities seem so extensive, that it appears well worth while to comply with the earnest desires of the large and growing body of bee keepers and to conduct some practical scientific work which will be of assistance to them. There is a great necessity for a thorough investigation of the contagious diseases of bees. Whole apiaries in some sections of the country have been completely destroyed by maladies about which nothing is known. Our extensive correspondence shows that there is a constantly increasing demand for information as to the possibilities of bee keeping in this country and in our recently added territories. The large bees of Oriental regions (*Apis dorsata*) should be studied in the Philippines and, if found possible, should be introduced into our Southern States. The apicultural product of the country at present is estimated at \$20,000,000 annually, but this is but a small part of the benefits which the country as a whole derives from this industry, since the yields of fruit and seed crops are largely increased by the presence of bees in numbers, this increase being brought about by cross fertilization through the agency of the bees. I therefore recommend that the appropriation be raised from \$2,000 to \$5,000 for the fiscal year 1903.

There has been for several years past a rapidly increasing demand for information regarding the destruction of forest trees by insects. This destruction in certain sections has been so great as to amount to serious loss. The Division, through publications and correspondence, has endeavored to supply the demand for information in regard to insects of this class, but the knowledge at hand is not commensurate with the situation, and a careful and extended investigation is urgently needed and is called for by the great forestry industries of the country. I therefore strongly urge that \$5,000 be appropriated for the fiscal year 1903 for the investigation of damage to forests and forest trees by insects.

REPORT OF THE ACTING CHIEF OF THE DIVISION OF BIOLOGICAL SURVEY.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF BIOLOGICAL SURVEY,
Washington, D. C., September 30, 1901.

SIR: I have the honor to submit herewith a report of the work of the Biological Survey for the fiscal year ended June 30, 1901, with outline of work for 1902, and recommendations for 1903.

Respectfully,

T. S. PALMER,
Acting Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

At the beginning of the year the assumption of the varied duties connected with carrying out the act of May 25, 1900, commonly known as the Lacey Act, necessitated some reorganization of the work of the Biological Survey. The Division is now practically divided into three sections, the work being distributed as follows: (1) Biological surveys and investigations of geographic distribution of mammals and birds—under the immediate charge of the chief of the Division; (2) investigations to determine the economic relations of birds—in charge of Prof. F. E. L. Beal; (3) supervision of matters relating to protection of game and importation of foreign birds and animals—in charge of the assistant chief.

FIELD WORK.

During the year the field work necessary in making biological surveys and in investigating the distribution of mammals and birds was carried on in four States and Territories—California, Texas, Alaska, and New Mexico; also in Yucatan, Mexico; and in Athabasca, Keewatin, and Mackenzie, Canada. In several of these regions the work was a continuation of that begun several years ago. The biological survey in California, outlined in the report for last year, was conducted chiefly in that part of the Sierra Nevada lying between Lake Tahoe and the Yosemite Valley. Some work was also done in the northern Sierras between Beckwith Pass and Oroville, in the Coast Range near Mount St. Helena, and, during the spring of the present year, near Baird, Shasta County. The plans for this season contemplate a resumption of the work in the Sierras from July to October.

The work outlined for Alaska, in charge of W. H. Osgood, was restricted to the region about Cook Inlet. A report on this expedition has been completed for publication as North American Fauna No. 21.

For several years past field work has been progressing in the Southwest, with the object of making a comprehensive survey of the State

of Texas. It has now reached such a stage that probably by the close of this season sufficient data will have been secured to warrant the publication of a preliminary report. The field parties, as heretofore, were in charge of Vernon Bailey, chief field naturalist. The section of the State covered this year included a line from San Angelo to the Pecos River and the region west of the Pecos from the Rio Grande to the New Mexican boundary. The higher mountains lying within this region, such as the Chisos, Davis, and Guadalupe ranges, which vary in altitude from 8,000 to 9,500 feet, and the summits of which are covered with coniferous forests, received particular attention. The Chisos Mountains, a detached range near the Rio Grande, proved to be of especial interest, since they were found to be inhabited by several Mexican species which had not been previously detected in the United States. Some work was also done in northern Texas and in New Mexico, with a view to filling gaps in the field work of previous seasons. The investigations in Mexico, in charge of E. W. Nelson, were continued, the State of Yucatan being the field of operations. Several points in the interior were visited, and a trip was made to the island of Cozumel on the east coast. Important collections of mammals and birds were secured, among which those from Cozumel are of special interest.

The explorations in the Hudson Bay region, outlined in the last annual report, were successfully carried out by Edward A. Preble. The party visited several of the Hudson Bay posts and succeeded in penetrating to a point some distance north of Fort Churchill on the west side of Hudson Bay. The specimens collected have been partially examined, and a report on the trip is now in course of preparation. A similar trip was planned for the spring of 1901, and the party left Edmonton, Alberta, about May 1, with instructions to proceed northward by way of Athabasca River to Great Slave Lake, making stops at several points along the route. The material gathered on these two expeditions will be of unusual interest, not only in the study of the distribution of species occurring along the northern border of the United States, but also for comparison with the material obtained in similar field work in southern Alaska. Mention should be made of the cordial cooperation on the part of the Hudson Bay Company in arranging for these two trips and in furnishing means of transportation. Without this cooperation it would have been impracticable for the field parties to have penetrated far into the regions to which they were assigned.

ECONOMIC RELATIONS OF BIRDS.

The total number of bird stomachs in the collection June 30, 1901, was 36,780, an increase of 2,483 over the number that had been received to June 30, 1900. Of these, 2,236 were examined during the year as against 1,989 examined during the previous year. The number of stomachs examined in each of the principal groups was as follows:

Thrushes	641	Flycatchers	141
Titmice	326	Swallows	125
Sparrows	297	Miscellaneous	262
Orioles	224		
Woodpeckers	220	Total	2,236

The data obtained from the examination of the 297 sparrow stomachs were utilized in the report on the food of sparrows which has been in course of preparation for several years but is now completed. Spe-

cial attention has been paid to the food of orioles, woodpeckers, flycatchers, and swallows, with a view to supplementing former reports in the case of the first two groups and preparing preliminary reports in the case of the last two.

More than 25 per cent of the stomachs were examined in connection with the preparation of a report embodying the recent field investigations conducted by Dr. S. D. Judd, which will shortly appear.

Numerous complaints have been received during the past few years concerning the damage done to fruit on the Pacific coast by the house finch (*Carpodacus mexicanus frontalis*), blue jay (*Aphelocoma californica*), western robin (*Merula migratoria propinqua*), and other birds. In May of the present year Prof. F. E. L. Beal was dispatched to California to visit the principal fruit-growing sections of the State and to make a personal investigation of the depredations in the orchards. Professor Beal first made his headquarters at Haywards, Alameda County, studying the conditions in the various fruit-growing sections about San Francisco Bay, observing the birds at the time when the fruit was ripening, and collecting material for study in the laboratory. He also visited southern California and the orchards and vineyards in the vicinity of Fresno in the upper San Joaquin Valley. The data obtained through these investigations will throw much light on the economic status of the birds studied in California, but the amount of material thus far received indicates that several months will be required for its examination and the preparation of the results for publication.

THE LACEY ACT.

In carrying out the provisions of the Lacey Act the Department has been brought into close relations with several of the other Executive Departments, with State officials, and with game-protective associations throughout the country. Four of the Executive Departments are now cooperating in the enforcement of this law—the Treasury Department in carrying out regulations for the importation of foreign birds and animals, the Department of the Interior in preventing illegal shipments of game from the Indian Territory, the Department of Justice in prosecuting violations of the Federal statute, and the Department of Agriculture in assisting in the enforcement of the law, issuing permits for the entry of foreign birds, and collecting and disseminating information concerning birds and game.

In the absence of an adequate appropriation, which would admit of carrying out all the provisions of the law, the Department has devoted its attention largely to the educational side of the work as the one likely to yield the best results in proportion to limited expenditures. In pursuance of this policy information concerning game laws has been collected and published in the form of popular bulletins, and aid has been freely rendered to all efforts to arouse public interest in the protection of birds and game. In the publications the more important details of the various State laws have been arranged in a form convenient for comparison, and a comprehensive definition of game, a uniform plan of stating close seasons, and a regular sequence of treating of the various kinds of game have all been adopted. These details tend to simplify many of the complexities of game legislation. The demand for the published bulletins and for special information on game protection has been unexpectedly large and is increasing to such a degree that it is becoming more and more difficult to meet all requests. The interest in bird protection aroused through the passage of the

Lacey Act has extended to all classes and to all sections of the country. Never before has so much attention been given to game legislation, and intelligent interest in the subject has been clearly exemplified in the numerous improved game laws enacted at the recent sessions of the State legislatures. Efforts have been made to place the subject on a higher plane and to secure greater uniformity in the laws of adjoining States. In several instances these efforts, in which national organizations have cooperated with State legislatures and officials, have met with marked success, as shown by the enactment of a practically uniform law for the protection of insectivorous birds in eight States and the District of Columbia. Greater uniformity confers a twofold benefit: It makes the State laws far more effective and it strengthens the Federal statute which rests upon these local laws as a basis. Thus, it can safely be said that the Lacey Act has been materially strengthened as a result of the legislation of 1901.

ADDITIONAL GAME-PROTECTIVE LEGISLATION NECESSARY.

The Federal statute has not only been the means of giving greater efficiency to local laws, but it has brought to light many weak points in both Federal and State laws which should be remedied by further legislation. Especially is this true of the Federal statutes relating to Alaska, the Indian Territory, and the forest reserves. Alaska has practically no game law; the Indian Territory is protected only by a statute enacted in 1832 which fails to meet modern requirements; and the forest reserves are greatly in need of a law which will either make them game preserves or provide for the establishment of game refuges in certain parts of the reserves suitable for this purpose. These Territories and reservations constitute the natural ranges of most of the big game now remaining in the United States, and with adequate legislation may be made the means of preserving certain species indefinitely.

IMPORTATION OF FOREIGN BIRDS AND ANIMALS.

With the cordial cooperation of the Treasury Department a system for keeping account of and exercising control over wild animals and birds imported from foreign countries was devised and put into operation at the beginning of the fiscal year. Under this system, permits issued by the Department of Agriculture must be presented to the proper customs officers at the port of entry before the animals or birds can be admitted. Large shipments and those containing species whose identity is in doubt are subject to examination by special inspectors, and quarterly reports of actual entries from customs officers, transmitted through the Treasury Department, furnish a check on the operation of the law.

In view of the fact that the law was unknown to many importers at the time it went into effect, that the importations were often made at remote ports of entry, and that in many cases a delay of a few hours might have meant serious loss in the case of tropical animals arriving at northern ports during the winter, it is gratifying to note that only one or two complaints have been received of losses due to delay, and that for these the Department was not responsible. Everything possible has been done to facilitate prompt entry. Arrangements have been made by which permits may be had on telegraphic request, so that within an hour after the receipt of the request the collector of

customs at any port of the United States can be notified that the permit has been issued. Special inspectors, who can, when necessary, examine consignments immediately upon arrival, have been appointed at six of the most important ports, viz, Boston, New York, Philadelphia, Baltimore, New Orleans, and San Francisco. Finally, the list of species which may be imported without permits has been materially extended. During the first three months after the law went into operation permits were required for practically all foreign animals, birds, and reptiles. On September 13, 1900, however, an order was issued by the Secretary of Agriculture, which exempted on and after October 1, 1900, 30 of the largest and best known animals, 3 well-known groups of birds, and all reptiles. The object of this order was to avoid the trouble and annoyance incident to securing permits for the importation of well-known harmless species. It was intended that this list should include no species that could not be identified without the aid of experts, but as a few animals requiring permits have been brought in under the names of one or two species in the excepted list, further slight modifications may be necessary.

During the year 186 permits were issued, covering the entry of about 350 mammals, 10,000 birds, and 38 reptiles. The reptiles include only those arriving during the first three months of the fiscal year, and the number of mammals is much smaller than it would be had there been no order of exemption. Among the birds were 626 pheasants, 4,237 quail, about 1,000 other game birds, and 4,147 cage birds. Among the importations of special interest may be mentioned a young giraffe from west Africa, several chimpanzees, and some Cuban flamingoes.

The numbers given are somewhat in excess of actual importations. Applications for permits frequently contain merely estimates of the number of animals or birds expected, and, through deaths en route or failure on part of foreign agents to fill orders, the number actually arriving in any consignment is apt to fall short of that designated in the permit.

The law has accomplished the main object for which it was enacted, namely, the exclusion of the mongoose and similar pests. Moreover, through its enforcement certain important information has been obtained regarding the importation of live game birds and of cage birds for exhibition. It appears that a considerable trade in Old World pheasants is conducted with the Province of Ontario, the birds being imported chiefly by way of Detroit and Niagara Falls; there is also a regular trade in live Chinese quail at the port of San Francisco, where more than 4,000 birds from Hongkong were brought in for market purposes and sold to Chinese residents of the city between December, 1900, and June, 1901. Cage birds are imported chiefly from Germany, Australia, China, and Japan, through the ports of New York and San Francisco, and many parrots from Mexico and Central America are landed at New Orleans and San Diego.

So far as known to the Department, only 3 specimens of the mongoose were imported during the year. One of these arrived at Philadelphia on the steamer *Urania*, from Jamaica, on May 20. Within twenty-four hours it was killed and deposited as a specimen in the Philadelphia Academy of Sciences. A second mongoose reached San Francisco in June, 1901, and was promptly destroyed. A third was reported from Los Angeles, Cal., in June, but investigation showed that it had arrived several months previously from some port on the Gulf coast, and had died in January. So far as known at present there are no live speci-

mens of the mongoose in the United States, except a few in confinement in zoological gardens. A strict enforcement of existing regulations should effectually prevent the entrance of this or any other pest.

INTERSTATE COMMERCE IN BIRDS KILLED OR POSSESSED IN VIOLATION OF LOCAL LAWS.

During the year numerous cases of violation of game laws have been called to the attention of the Department, of which 57 have received careful investigation. Of those taken up, 8 resulted in conviction,¹ 33 are awaiting action by the courts, 8 are still in the hands of the Department awaiting further evidence, and 8 have been dropped for want of evidence. These cases originated in 12 States and Territories, viz, Arkansas, Indiana, Indian Territory, Iowa, Kansas, Maryland, Missouri, New Jersey, Oklahoma, South Dakota, Tennessee, and Texas, and involved the seizure of 11,940 quail, 974 prairie chickens, 387 miscellaneous game, and 2,608 plume birds, or a total of nearly 16,000 birds. Of the 41 cases acted upon by this Department, 14 were referred to local authorities and 27 were transmitted to the Department of Justice for prosecution in the Federal courts. As a rule, the causes of action have arisen through shipment of birds killed in violation of local laws, and the large proportion of cases still undisposed of at the close of the year is due to the fact that in most instances attention was not called to the offenses until several months after they were committed; moreover it frequently happened that the most important fact—the shipper's name—was unknown, and the Department was called upon to assist in obtaining the necessary evidence, often a very slow and tedious process.

The aid of the Department has been sought in connection with the enforcement of the provisions against illegal shipment of game to a greater extent than was anticipated. Such aid has been freely rendered, though it has been the aim to confine action merely to supplementing the efforts of local authorities, and to refer cases to State authorities for action, whenever possible. The provisions of the law are such that violation of the Federal statute necessarily involves a previous violation of a local law, and it is possible, therefore, to prosecute cases either in local or Federal courts. Whenever conditions have been favorable to success in State courts, or the evidence in the hands of the Department has been such as could be used in a prosecution in such courts, the case has been promptly turned over to local authorities; otherwise it has been referred to the Department of Justice.

In this connection mention should be made of the cordial cooperation of Federal and State officers, as well as railroad and express companies, game protective associations, and various individuals. These have rendered every assistance in their power in the enforcement of the Federal law. Important aid has been received from the State game commissioners or wardens of Illinois, Iowa, Maine, and Michigan, by the American, Pacific, United States, and Wells Fargo Express companies, and by the Game and Fish Protective Association of Maryland, the League of American Sportsmen, and the American Ornithologists' Union.

¹Three of these convictions have been obtained since July 1, 1901. Mention should also be made of five other convictions secured in the State courts of Iowa. In these cases the birds were seized in transit and the evidence was referred by the deputy United States marshal directly to the State game warden for action.

Of the cases above mentioned, 54 involved game birds and 3 nongame birds. The first case under the Lacey Act reported to the Department was one involving the shipment of 72 young prairie chickens from St. Louis to Chicago in July, 1900. These birds were shipped under a cipher address, without statement of contents on the package, and were intercepted in transit, so that neither the carrier nor the consignee could be held responsible, and as the shipper could not be located the case was dropped. The first case acted upon by a Federal court involved the shipment of a small package of millinery samples (containing among others 7 gulls and terns) from Brownsville, Tex., to New York City in December, 1900. The shipper was indicted, promptly plead guilty, and paid his fine, and the case was concluded within a few weeks after it was first reported.

A case which perhaps attracted more general attention than any other was one based on information received by the Department in September, 1900. The matter was referred to the local authorities in Baltimore for action, and resulted in the seizure and confiscation of 2,600 plume birds, offered for sale in violation of the State law of Maryland. The case was prosecuted through three courts by the Maryland Fish and Game Protective Association, and the dealer was compelled to pay a fine of \$100 and costs. This action attracted widespread attention in the millinery trade, and brought the Department into correspondence with the leading wholesale millinery firms in Eastern cities. The wholesale houses in Baltimore promptly withdrew gulls and terns from sale, and assurances were received from the Millinery Merchants' Protective Association and from leading houses in Boston, New York, Philadelphia, and Baltimore that they would, so far as possible, withdraw from sale and discourage the use of these and other birds protected by local laws.

The effectiveness with which such cases can be disposed of under certain State laws is well illustrated by one instance in which, through the energy of the game warden of Iowa, a conviction was secured and the fine paid within three weeks after the evidence had been forwarded from the Department. Convictions have been secured in a majority of the cases involving illegal shipments from Iowa and the penalty imposed in each of seven cases was a fine of \$100 and costs, and in another imprisonment for thirty days.

But the results of the enforcement of the law are not to be measured by the number of prosecutions or by the severity of the penalties imposed. Attention has been called to local laws which had long remained dead letters; the methods of shipping game and the devices resorted to in evading the regulations have been investigated, and information thus secured can be used in preventing similar violations; it has been shown that evidence of illegal shipments that will insure conviction can be obtained a thousand miles from the shipping point and months after the offense is committed; and, finally, it has been demonstrated that shippers are no longer safe as soon as their game has crossed a State boundary.

PUBLICATIONS.

The publications of the year include 2 numbers of North American Fauna (Nos. 18 and 19), 2 bulletins (Nos. 13 and 14), 2 articles in the Yearbook of the Department for 1900, 6 circulars (Nos. 28-33, inclusive), the report of the Division for 1900, and reprints of one of the circulars and three previous publications.

The two numbers of North American Fauna issued were No. 18, "Revision of the pocket mice of the genus *Perognathus*," by W. H. Osgood; and No. 19, "Report of a biological reconnoissance of the Yukon River region," by W. H. Osgood and Dr. Louis B. Bishop. Both of these numbers, as well as Bulletin No. 13, on "Food of the bobolink, blackbirds, and grackles," by Prof. F. E. L. Beal, were mentioned as being in press at the time of the last report. Bulletin No. 14, on "Laws governing the transportation and sale of game," by T. S. Palmer and H. W. Olds, was issued in an edition of 5,000 copies, a number which would have been inadequate to meet the demand had it not been preceded by a 32-page circular (No. 31) containing an abstract of the matter presented in the bulletin, of which circular 15,000 copies were distributed. There is a large demand for publications concerning game, especially on the part of railroad and express companies, and in several instances the Department has received single applications for almost as many copies as were issued in the regular edition. Applicants are usually willing to purchase such reports, but under the present law there is no provision for sales in the quantities desired. As such publications are intended largely for the use of State officials and common carriers in order to secure better enforcement of the game laws, a liberal distribution is advantageous to the Department. An effort has therefore been made to secure as wide a distribution as possible by the preparation of special circulars and tables, which can be issued in large editions at comparatively small cost. The Department is not, however, in a position to meet an unlimited demand, and unless special provision for the purpose is made it will soon be unable to supply many applicants who need the reports and will put them to good use.

The Yearbook articles related to economic ornithology, and were entitled "How birds affect the orchard," by Prof. F. E. L. Beal, and "The food of nestling birds," by Dr. S. D. Judd.

The circulars, six in number, were as follows: No. 28, "Directory of State officials and organizations concerned with the protection of birds and game;" No. 29, "Protection and importation of birds under act of Congress approved May 25, 1900;" No. 30, "Wild animals and birds which may be imported without permits;" No. 31, "Information concerning game;" No. 32, "Directions for the destruction of prairie dogs," and No. 33, "Protection of birds and game—Directory of State officials for 1901."

The original edition (5,000 copies) of circular No. 31 was exhausted almost immediately, and it was necessary to publish reprints to the number of 10,000. Reprints of North American Fauna, No. 16, "Biological survey of Mount Shasta," and bulletin No. 12, "Legislation for the protection of birds other than game birds," were also necessary. Owing to the unabated demand for Farmers' Bulletin No. 54, "Some common birds in relation to agriculture," a tenth edition, of 20,000 copies, was issued during the year, which makes a total of more than 220,000 copies of this bulletin thus far printed since its first appearance in 1896.

ROUTINE WORK.

The routine work of the office has increased very largely during the year. The number of letters received was 6,540, and the number written about 4,000. This is an increase of more than 50 per cent over the number received (4,253) and mailed (2,041) in 1900. The miscellaneous office work includes examination and filing of reports, sched-

ules, and notes received from correspondents; distribution of several hundred schedules twice each year to migration observers; arrangement of reports and notes received from field naturalists; examination and recording of accounts; care of collections; examination and packing of specimens sent in for identification; forwarding supplies to field naturalists; bibliographical work; and preparation of reports for publication. During the past few months the valuable and rapidly growing collection of photographs taken by members of the various field parties has been rearranged and rendered much more accessible for reference, so that any print and its corresponding negative can be examined at a moment's notice. An important part of the work consists of issuing permits for the entry of foreign birds and animals, investigating complaints regarding violations of the Lacey Act, and answering inquiries concerning local game laws. This work is exacting, requires prompt and unremitting attention, and is constantly increasing. In the last annual report attention was called to the necessity for making some provision for handling the increased correspondence, but as yet no addition has been made to the clerical force, and the energy and ingenuity of the present force are frequently taxed to the utmost to meet the current demands promptly. The recommendation is therefore made that two additional assistants (one a stenographer) be provided for in the next appropriations.

OUTLINE OF WORK FOR THE YEAR 1902.

FIELD WORK.

The plans for field work for the current year, at least so far as this summer is concerned, have already been outlined in reviewing the work for the past fiscal year. They comprise a continuation of the biological survey in California in the High Sierra immediately about the Yosemite Valley and in the region farther south on the Kaweah and Kings rivers. In Texas, field work will be continued in the extreme western end of the State, and an effort will be made to prepare for publication the results of investigations conducted during the past two or three years. The work thus far outlined for Canada contemplates merely a completion of operations along the route from Edmonton, Alberta, to Great Slave Lake.

STUDIES OF THE FOOD OF BIRDS.

The large amount of material collected by Professor Beal in the course of his investigations in the fruit-growing sections of California will be examined in the laboratory, and a report on the results of this examination will be prepared for publication. This report should be of much value in aiding to fix the status of the birds that are charged with damaging California orchards.

A plan is also in contemplation for undertaking an investigation of the food habits of certain game birds as soon as sufficient material can be brought together. The results will doubtless be of value not only to the farmer, but more especially to persons who are interested in game preserves and in restocking covers or improving breeding grounds for the purpose of increasing the local abundance of game.

ENFORCEMENT OF THE LACEY ACT.

The inspection service necessary to prevent importation of noxious birds or animals will be strengthened and improved so far as means

at the command of the Division will permit, and will be extended in the near future to Hawaii. While, as a rule, every effort will be made to facilitate the prompt entry of foreign birds and animals, inspection at the principal ports will be increased, and no effort will be spared to prevent the introduction of species which are likely to prove injurious. In this service lies the chief protection against the introduction of the mongoose and of pests like the English sparrow. The losses which would occur if certain foreign species should once gain a foothold in this country would be enormous in comparison with the small expense necessary to maintain the service on an efficient basis.

The demand for information on game will be met, so far as possible, by the publication of reports on various topics connected with game preservation. A compilation of existing game laws, including the changes made during the present year, will be prepared, accompanied by tables showing in detail the close seasons for the various kinds of game, not only under State laws, but also by counties in the case of certain States which have many local regulations. Besides the investigation of the food of game birds, mentioned above, reports on shipment of game for propagation, on game preserves, and on introduced pheasants, are in contemplation. Much interest has been shown in the introduction of game birds into new localities, or into regions where they have become rare, and many applications have been received for quail and pheasants. The Department has also received offers of birds for introduction, and has been tendered the use of land for making experiments of this kind, but the distribution of game birds, or the acceptance of birds for experiment, has been prevented by lack of a specific appropriation necessary for transportation and maintenance. In view of the activity on the part of game associations and individuals in introducing quail and pheasants, it is an open question whether the introduction of these birds should not be left entirely to private enterprise, and the efforts of the Department devoted to other equally important species that have received comparatively little attention. Several valuable game birds of limited distribution, such as the California mountain quail (*Oreortyx pictus plumiferus*), the Arizona wild turkey (*Meleagris gallopavo merriami*), and the sharp-tailed grouse (*Pediacetes phasianellus campestris*) would thrive in other regions, and are worthy of the attention of persons interested in introducing new species of game birds. While the Department can not at present make any experiments of this kind, it may be able to advise as to the introduction of these species, and to aid persons interested in such experiments in obtaining birds for propagation.

MIGRATION OF BIRDS.

Ever since its organization, the Division has been collecting data on the migration of birds, and Bulletin No. 2, published in 1888, under the title, "Bird migration in the Mississippi Valley," was based on observations made during the years 1884 and 1885. Since then schedules have been distributed regularly, and notes have been brought together, but until the present year no effort was made to prepare the accumulated data for publication. An arrangement has now been entered into with Prof. W. W. Cooke, the author of the bulletin mentioned, to devote a few months of the summer of 1901 to the elaboration of some of the notes on migration. As the time available for this work is limited, Professor Cooke has selected about sixty of the more important migratory land birds that breed in the United States

but pass the winter in the Tropics, and has undertaken to work out the winter distribution of these species, and ascertain, so far as data will permit, the routes they traverse in passing to and from their breeding grounds. This investigation promises to bring to light many facts of interest to the student of bird migration, and it is unfortunate that present appropriations will not permit a more complete elaboration of the data on hand.

In this connection it should be stated that much valuable material in the form of notes and original observations on birds and mammals has been brought together by the Division, but still remains unpublished. Provision should be made for publishing some of this material, which has been collected at considerable expense, so that it may be made generally available.

DESTRUCTION OF PRAIRIE DOGS.

During the year complaints concerning the depredations of prairie dogs have been received from about 325 correspondents in the plains region of the West. These complaints came from nearly 300 localities, distributed chiefly in the States of Colorado, Kansas, Montana, Nebraska, South Dakota, Texas, and the Territory of Oklahoma, and indicate that in many sections of these States the destruction of prairie dogs is one of the most serious questions confronting the farmer or cattle owner. In the last annual report attention was called to the necessity for a thorough investigation of the subject, and the need of making provision for carrying on the work; but the necessary appropriation was not made by Congress, and the Division is therefore unable, at present, to undertake a comprehensive study of the question.

Owing to the numerous complaints received, however, and the urgency of the demands for information on this subject, a preliminary investigation will be made in the States of North and South Dakota, Kansas, and Nebraska, and some work will also be done in Texas. The data thus far secured by the Division will be utilized in the preparation of a report to be published at an early date. The main problem is to ascertain the poison which may be used most effectively for this purpose, and the minimum cost at which prairie dogs may be destroyed under various conditions. It is well known that bisulphide of carbon will destroy the animals, but the high price at which it is sold in many places in the West prevents its use and gives rise to a general demand for a cheaper and equally effective poison. One great difficulty encountered in using poison is that prairie dogs feed mainly on herbage, and refuse ripe grain when grass or similar food can be obtained. The problem, therefore, resolves itself practically into three phases: (1) Obtaining bisulphide of carbon at lower rates; (2) discovery of some bait which will render the use of strychnine, cyanide of potassium, and similar poisons effective at any season; or (3) the discovery of some substance or combination of substances which will be cheaper than bisulphide of carbon or strychnine, and at the same time equally effective. On the solution of this problem depends the success or failure of many residents in the West who are attempting to cultivate lands in regions infested with prairie dogs.

Prairie dogs occur from Texas to Montana and from Kansas to Arizona, so that nearly a dozen States are interested in the destruction of the pest. This fact alone shows the importance of providing means for a thorough investigation of the whole question of prairie-dog destruction.

RECOMMENDATIONS.

The estimates for the fiscal year 1902 included an increase of \$10,000, to provide for the additional work assigned to the Division. The increase actually appropriated was, however, but \$2,500, of which sum \$1,000 was made immediately available and was almost all expended before the close of the fiscal year. The increase available for the year 1902 was therefore practically reduced to \$1,500, an amount which is inadequate to enable the Division to meet the many demands made upon it.

In submitting estimates for the fiscal year 1903 the following recommendations are therefore made: (1) An increase in the salary roll, to provide for two additional assistants, one a stenographer; (2) an increase of \$10,000 in the fund for biological investigations, to enable the Division to enlarge the scope of its field work, to place the inspection service required by the Lacey Act on a permanent basis, to investigate more fully the various methods of destroying prairie dogs, to elaborate and prepare for publication material already received, and to collect data and publish reports on birds and on game protection in sufficiently large editions to meet the general demand.

REPORT OF THE CHIEF OF THE SECTION OF FOREIGN MARKETS.

U. S. DEPARTMENT OF AGRICULTURE,
SECTION OF FOREIGN MARKETS,
Washington, D. C., September 1, 1901.

SIR: I have the honor to submit herewith the report of the Section of Foreign Markets for the fiscal year ended June 30, 1901.

Respectfully,

FRANK H. HITCHCOCK,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

As the publications of the Section of Foreign Markets grow in number and receive a wider circulation, bringing the object of this office more generally to the attention of the public, the inquiries received regarding our agricultural export trade continue to increase. The large correspondence now required to meet the demands for information that come through the mail forms an important part of the work of the Section.

INQUIRIES REGARDING TRADE WITH THE ORIENT.

Many of the inquiries received during the past fiscal year, like those of the year before, had reference to the Orient, the possibilities of commercial extension in that direction apparently being uppermost in the minds of those looking for foreign-trade opportunities.

COMPUTING MACHINES.

The work of preparing statistics in response to inquiries and for use in publications was greatly facilitated, as in prior years, by the utilization of the modern computing machines with which the office is now provided. Without the assistance of these machines a much larger clerical force would have been required to perform the necessary computations. The machines have proved to be an exceedingly important factor in the operations of the office.

NEW QUARTERS.

The removal of the Section during the latter part of the year to the more commodious quarters now occupied has been of great advantage. As previously quartered, the office was seriously hampered by lack of space and had to perform its duties under trying conditions. The rooms now occupied permit a more convenient distribution of the

work and make it possible to accomplish better results with an equal clerical force.

FOREIGN MAILING LIST.

Considerable time was devoted during the year to the proper classification of the foreign mailing list of the Section. It is highly important for this office to make a judicious distribution of its publications abroad in order that it may the more readily procure in exchange the numerous foreign publications required to obtain adequate statistics of the world's commerce.

PUBLICATIONS.

During the fiscal year 1900 the Section published seven bulletins and a circular, comprising in all 753 pages of printed matter.

REPORT ON OUR AGRICULTURAL EXPORT TRADE, BY COUNTRIES.

The first publication of the year was a report reviewing our agricultural export trade with the several foreign countries during 1895-1899. In this report, which was issued as Bulletin No. 20, the official statistics of exportation were so compiled and classified as to show in separate statements for each country of destination the nature and value of the various products of American agriculture there marketed.

REPORT ON OUR AGRICULTURAL IMPORT TRADE, BY COUNTRIES.

Following the publication just mentioned, a similar report, published as Bulletin No. 21, was issued on the subject of our agricultural imports. The special object sought in the preparation of Bulletins Nos. 20 and 21 was to secure a statistical arrangement making it possible to determine at a glance the extent and character of our agricultural exports to or imports from any given country. Besides affording a convenient medium for answering inquiries, these two reports proved to be exceedingly useful for reference in the general work of the office.

REPORT ON THE TRADE OF DENMARK.

Several years ago a report was planned regarding the foreign trade of Denmark, that country being of special interest agriculturally because of the success there attained in the development of an export trade in products of the farm. The completion of the report at that time was prevented, however, owing to the more urgent statistical work called for by the breaking out of the Spanish-American war. During the past year the material previously gathered on the subject of Danish trade was thoroughly revised, and after being supplemented by much additional matter, bringing the facts as nearly to date as the Danish statistics available would permit, was issued as Bulletin No. 2, taking the number the report would have received if published as originally planned.

REPORT ON OUR TRADE WITH SCANDINAVIA.

During the preparation of the report on the trade of Denmark some elaborate statistical tables were compiled regarding the commerce carried on between the United States and the three Scandinavian coun-

tries—Denmark, Sweden, and Norway—the intention being to append these tables as a part of that bulletin. It was found, however, that their inclusion would make the report too large for convenience, and they were accordingly made the subject-matter of a separate publication entitled “Our trade with Scandinavia,” and issued as Bulletin No. 22. This report gave a detailed statistical review of our trade with Scandinavia from 1890 to 1900, inclusive, supplementing with our own official statistics of importation and exportation the less detailed Scandinavian records published in the prior bulletins, Nos. 7, 8, and 9, relating to Norway, Sweden, and Denmark, respectively.

The value of the several reports regarding Scandinavian commerce was considerably enhanced by the fact that little had previously been printed in the English language on this subject. By the statistics presented it was shown that these countries of northern Europe, and especially Denmark, furnished interesting examples of aggressive foreign-trade development. Their commerce with the United States increased in value from \$12,000,000 in 1890 to \$34,000,000 in 1900, a gain of nearly 200 per cent for ten years.

Notwithstanding the fact that agriculture is a prominent industry in Scandinavia, the United States marketed there during 1900 over \$20,000,000 worth of farm products, these products forming in value about 70 per cent of our total domestic exports to that destination. Indian corn, oil cake and oil-cake meal, cotton, oleo oil, lard, and wheat and wheat flour were the principal items.

REPORT SUMMARIZING OUR FOREIGN TRADE IN AGRICULTURAL PRODUCTS.

The usual summary report reviewing the annual import and export trade of the United States in agricultural products, without detail as to sources and destinations, was published as Bulletin No. 23. This report analyzed the leading features of the returns for 1900 and compared the statistics for that year with the figures for 1899 and preceding years of the decade.

With the single exception of 1898 the fiscal year 1900 witnessed the largest exports of farm produce from the United States up to that time recorded. The aggregate value of these exports was \$845,000,000, or within \$15,000,000 of the exceptionally high figures for 1898. Compared with 1899 the returns for 1900 showed a gain of more than \$50,000,000. This remarkable increase over 1899 was explained in part, however, by the higher price of cotton, the exports of which, although actually smaller than in 1899, advanced nearly \$33,000,000 in total value.

Next to cotton, the largest gains in value occurred in the exports of meat products and live stock. Among the numerous other examples of increase, tobacco, fruits and nuts, vegetable oils, oil cake and oil-cake meal, seeds, and dairy products were the most conspicuous.

Our agricultural imports for the fiscal year 1900 had an aggregate value of \$420,000,000, forming nearly 50 per cent of the entire import trade. This record showed an increase of nearly \$65,000,000 over the figures of the year before, hides, silk, and wool being the leading factors in this growth. Considerable gains were also made in the importation of vegetable fibers, sugar, and tobacco.

REPORT ON THE SOURCES OF OUR AGRICULTURAL IMPORTS.

Two years ago a report was published on the sources of the agricultural imports of the United States, showing for 1894–1898 the annual

quantity and value of the various agricultural products received from the several countries of supply. During the past year this report was supplemented by a similar publication bringing the statistics of importation by countries down to date. This latter report covered the five-year period 1896-1900, and was issued as Bulletin No. 24.

While it required much time and labor to prepare a report of this character, the task seemed fully justified in view of the great usefulness of the earlier bulletin, which for two years was extensively utilized as a means of answering inquiries relative to the import trade, and also as a basis for statistical statements on that subject.

REPORT ON THE DISTRIBUTION OF OUR AGRICULTURAL EXPORTS.

The report of two years ago on the sources of our agricultural imports was prepared and issued in conjunction with a similar publication relating to the distribution of our agricultural exports. This report on exportation was also supplemented during the year by a later issue, published as Bulletin No. 25, bringing the subject-matter down to date in the same manner as that described for Bulletin No. 24. Like Bulletin No. 24, the report on the distribution of our exports covered the five-year period 1896-1900, showing in the greatest possible detail the annual quantity and value of the various products of American agriculture marketed in the several countries of destination.

The statistics published in Bulletin No. 25 disclosed some interesting examples of growth in our agricultural export trade during the five years. Perhaps the most striking of these examples was afforded by our shipments to Asia and Oceania. The value of the American farm produce marketed in Asiatic countries rose from \$5,735,000 in 1896 to nearly \$23,000,000 in 1900, the latter record far exceeding that for any previous year. In our agricultural export trade with Oceania there was an advance in value during the same period from \$3,986,000 to \$6,799,000. The figures for 1900, as in the case of Asia, were decidedly the highest ever recorded.

Of the Asiatic countries to which our exports increased, Japan was the most conspicuous. In 1900 we shipped to that country products of agriculture worth over \$15,000,000, while in 1896 the value of our consignments barely exceeded \$2,000,000. Each year subsequent to 1896 witnessed a decided gain.

Among the countries of Europe with which trade growth was recorded, Denmark furnished a notable example. Our agricultural exports to that country in 1896 were valued at only about \$5,000,000, whereas in 1900 their value rose to nearly \$15,000,000.

Another striking instance of growth occurred in our trade with British Africa, the value of the American farm produce sent to that destination increasing from \$5,300,000 in 1896 to \$10,300,000 in 1900.

One of the most interesting features of the trade during 1896-1900 was the rapid development of our agricultural exports to the new island dependencies. The value of domestic farm produce sent to Cuba, Porto Rico, Hawaii, and the Philippine Islands in 1900 exceeded \$20,000,000, as compared with only \$6,269,000 in 1896. These exports exhibited a gain during the five years of over 200 per cent.

The growth in our agricultural exports to Cuba was particularly marked. In 1896 our shipments to that island were at low ebb, having a value of less than \$4,000,000, but since then there have been important gains each year, culminating in 1900 with a value of \$14,000,000.

CIRCULAR ON AGRICULTURAL IMPORTS AND EXPORTS.

In order to permit a more general distribution of the leading facts printed in Bulletin No. 23, some statistics prepared for that report were afterwards published in a small pamphlet issued as Circular No. 23.

TESTIMONY BEFORE THE INDUSTRIAL COMMISSION.

At the invitation of the United States Industrial Commission, the chief of the Section appeared before that body as a witness on the subject of our agricultural export trade. His testimony dealt largely with trade methods and conditions, pointing out in particular certain obstacles that confront our exporters of farm produce, and offering some suggestions with regard to possible remedies. As these matters had not been so fully covered in the publications of the Section, it was recommended by the Editor of the Department that the testimony be reprinted and issued as a departmental report. This plan was carried out during the past year, the testimony in question being published as Report No. 67 of the Department, under the title "Foreign markets for American agricultural products."

AGRICULTURAL EXPORTS DURING 1901.

From statistics recently compiled by the Section, it appears that the past fiscal year was marked by the largest agricultural export trade in our history, the value of the domestic farm produce marketed abroad during the twelve months ended June 30, 1901, exceeding the enormous sum of \$950,000,000. The largest previous value was that for the fiscal year 1898, amounting to \$859,000,000. Next to these figures the highest record occurred in 1900, when farm products worth \$845,000,000 were sent abroad. Compared with the exports for 1900, the increase during 1901 was quite extraordinary, amounting to \$105,000,000.

The products that contributed most to the remarkable gain of the past fiscal year were cotton, wheat, cattle, lard, hams, cotton-seed oil, and fresh beef. Our exports of cotton for 1901 had a value of \$315,000,000, showing an increase of \$72,000,000 over the figures for 1900. In the wheat exports there was a gain of \$24,000,000, the value for 1901 advancing to \$97,000,000. The exports of cattle rose to \$38,000,000, showing an increase of \$7,000,000 for 1901. In the case of lard there was an advance of \$5,000,000, the record for 1901 being \$47,000,000. The exports of hams, of cotton-seed oil, and of fresh beef showed in each instance a gain of over \$2,000,000, the value of the hams sent abroad advancing to nearly \$23,000,000, that of the fresh beef to \$32,000,000, and that of the cotton-seed oil to \$17,000,000.

Other items in our agricultural export trade, the value of which increased more than \$1,000,000 during 1901, were oil cake and oil-cake meal, wheat flour, salted or pickled pork, oleo oil, horses, and sheep.

TRADE WITH INSULAR DEPENDENCIES.

Some statistics have also been compiled by the Section relative to the trade in agricultural products carried on during the past fiscal year between the United States and the new insular dependencies, with the exception of the Hawaiian Islands. Unfortunately, no official returns are now made of the exports from the United States proper

to the last-mentioned islands, the Hawaiian group being treated in our foreign-commerce returns as an integral part of the country.

The statistics of our exports to Cuba, Porto Rico, and the Philippine Islands show that during 1901 we sent to these three destinations \$18,600,000 worth of farm produce, the shipments comprising in value about 53 per cent of all the domestic merchandise marketed in these various islands. As compared with our agricultural exports to Cuba, Porto Rico, and the Philippines, in 1900, valued at \$17,551,000, the record for 1901 discloses a slight increase. The gains occurred in the trade with Porto Rico and the Philippines, the value of our agricultural exports to the former island advancing during the two years from \$2,311,000 to \$3,500,000, while in the case of the Philippines there was an increase from \$1,657,000 to \$2,500,000. Our agricultural exports to Cuba, on the other hand, exhibited a slight falling off in 1901, the record for that year being \$12,600,000, as against \$13,583,000 for 1900.

As regards our import trade with Cuba, Porto Rico, and the Philippines, the records for 1901 show a large increase in the amount of agricultural produce received from those sources, the value for that year amounting to \$48,600,000, while in 1900 it was only \$36,162,000. The chief part of this increase took place in our imports from Cuba, which advanced from \$27,226,000 in 1900 to \$38,700,000 in 1901. There was also a considerable gain in our importations from Porto Rico, the value for 1901 being \$5,500,000, as compared with only \$2,991,000 for 1900. In the case of the Philippines a noticeable decline occurred, the value falling from \$5,945,000 in 1900 to \$4,400,000 in 1901.

OUR COMMERCE ON THE PACIFIC.

In the month of June the chief of the Section of Foreign Markets was detailed to accompany the Committee on Rivers and Harbors of the United States House of Representatives upon its tour of inspection to the ports and waterways of the Pacific coast. This trip afforded a favorable opportunity for the collection of certain information relative to the agricultural export trade of the various ports visited. The facts gathered will be utilized to advantage in the future work of the office.

AGRICULTURAL EXPORT TRADE OF THE PACIFIC PORTS.

During the fiscal year 1900 over \$70,000,000 worth of domestic merchandise was sent abroad through our Pacific ports. Of this merchandise, about \$45,000,000 worth, or considerably more than half, consisted of farm produce.

Among the agricultural exports from the Pacific coast in 1900, breadstuffs formed decidedly the most important item, the shipments under this head amounting in aggregate value to about \$28,000,000. Wheat and wheat flour comprised a large part of the item, the exports of wheat in the grain being valued at \$13,800,000, and the exports of wheat flour at \$8,700,000. Next to wheat, the principal grain exported was barley, of which there were shipments worth \$4,300,000. Oats were exported to the value of \$208,000. Bran, middlings, and mill feed formed an item of \$225,000, and bread and biscuit one of \$176,000.

After breadstuffs the principal agricultural export from the Pacific coast in 1900 was cotton, the shipments of which had a value of nearly \$8,000,000.

Fruits also occupied an important place in the Pacific export trade, the consignments for 1900 amounting in value to over \$3,000,000. Canned fruits formed the principal part of these exports, having a value of about \$2,400,000, while the shipments of fresh and dried fruits were valued at a little more than \$600,000.

Another leading item was that comprising the various meat products, the exports of which had an aggregate value of \$1,086,000. Canned beef, hams, lard, and bacon were the principal articles. The value of the canned beef exported was \$205,000, that of the hams \$199,000, that of the lard \$143,000, and that of the bacon \$111,000.

Live animals, and especially mules and horses, were also shipped quite extensively. Mules formed an item of \$427,000 and horses one of \$347,000. The exports of animals of all kinds amounted in total value to about \$950,000.

There was a considerable exportation of malt liquors through our Pacific ports in 1900, consignments worth \$662,000 being reported.

Dairy products were exported to the value of about \$600,000. Milk formed an item of \$311,000 and butter one of \$212,000. The exports of cheese were comparatively small.

Ginseng was an item of considerable importance, the shipments of this product having a value of \$426,000.

Vegetables comprised an item of \$414,000. Potatoes, valued at \$123,000, were the principal exports in this class.

There was also an important export trade in wines, the shipments of the year amounting in value to \$412,000.

Other agricultural exports from the Pacific coast in 1900 with a value exceeding \$100,000 were as follows: Hay, \$376,000; distilled spirits, \$366,000; leaf tobacco, \$336,000; rice, \$296,000; and refined sugar, \$139,000.

PLANS FOR THE CURRENT FISCAL YEAR.

In addition to the three trade reports that are now issued annually by the Section, corresponding to Bulletins Nos. 23, 24, and 25 of the past fiscal year, and later issues of which are in course of preparation, several publications have been planned with the object of making more readily available the official import statistics, so far as they relate to farm produce, of the principal foreign countries. A report on the agricultural imports of the United Kingdom has already been begun, to be followed by similar publications in reference to other nations. The special object of these reports will be to show what proportion of the various products of agriculture, needed by these countries to meet their domestic requirements, is being furnished by the United States and by other producing countries. It is believed that statistics of this character will be exceedingly useful in pointing out the directions in which our agricultural export trade shows the greatest opportunities for development.

The preparation of the exhaustive report on Chinese commerce, for which considerable matter has already been compiled, will be continued, and it is hoped that before the end of the current fiscal year its publication will be possible.

REPORT OF THE LIBRARIAN.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE LIBRARIAN,
Washington, D. C., August 29, 1901.

SIR: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1901.

Respectfully,

JOSEPHINE A. CLARK,
Librarian.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

ACCESSIONS TO THE LIBRARY.

During the past year the accessions to the Library have numbered over 4,000 books and pamphlets. These accessions have included many reference books of especial value in the work of the Department and a large number of scientific periodicals. The following are among the most noteworthy acquisitions to the Library during the year: Martius's *Historia naturalis Palmarum*, 3 folio volumes, fully illustrated; the latest edition of Beilstein's *Handbuch der organischen Chemie*, a standard work in chemistry; Doubleday and Westwood's *Genera of Diurnal Lepidoptera*, 2 volumes, and Leech's *Butterflies from China, Japan, and Korea*, 3 volumes, both of which works are richly illustrated by colored plates. *Archiv für Zoologie und Zootomie*, 1800-1805, *Der Naturforscher*, 27 volumes, 1774-1793, and *Belgique horticole*, 35 volumes, completing the Library copy, are among the valuable additions to the periodicals. At the sale of the library of the noted naturalist Henri Milne-Edwards, in Paris, over sixty works on zoology were obtained, many of which are rarely available for purchase. To the class of books on gardening such publications as *Gardens Old and New*, *Cook's The Century Book of Gardening*, and *Henderson's Picturesque Gardens* have been added.

PERIODICALS.

The periodicals and serial publications currently received by purchase and by exchange number considerably over 2,000. These publications include farm papers, technical scientific journals, and serial publications of learned societies from all parts of the world. The widespread distribution of the Department publications on condition of exchange has materially enlarged the collections of foreign serials during the past few years. This class of accessions to the Library is the largest and it is the most valuable in the current work of the Department.

CATALOGUE.

The cataloguing of the Library has progressed more rapidly than before on account of the increased number of cataloguers. The "Catalogue of periodicals and other serial publications in the Library of the U. S. Department of Agriculture," which has been completed the past year, is the most important work in special cataloguing which has been done. This catalogue comprises entries for over 4,000 periodicals and serials, and is the beginning of a printed subject catalogue, which will appear in parts in a series of Library bulletins.

In addition to the regular work on the catalogue two reference lists on special subjects have been in progress; one list comprises references to publications on irrigation and land drainage, and the other, references to publications on tobacco, both of which will soon be completed and appear as Library bulletins.

REFERENCE WORK.

The enrollment of scientific aids and student assistants in the Department to pursue special lines of work and study has largely increased the amount of reference work in the Library; also certain collections in the Library which are more nearly complete than are to be found elsewhere in the country have afforded assistance to scientists at a distance, who have been engaged in special investigations and monographic work.

Many teachers and pupils of the public schools in Washington have availed themselves of the privilege of consulting works in the Library, especially those on natural history.

PUBLICATIONS.

The quarterly bulletins of accessions to the Library have been regularly issued, comprising about 100 printed pages. The "Card index to the Department publications" has been continued, but, on account of the limited funds for printing, the issues have been few in number, a fact to be regretted, inasmuch as this publication has proved to be a valuable key to the Department publications and has led to more careful arrangement and preservation of these documents for public use.

BINDING.

The preparation of books for binding has been kept up to meet the current needs. The number of books bound, 814, included chiefly periodicals, since it has been necessary to make a selection from the large number of volumes awaiting binding. A lack of available funds has prevented the necessary binding of a great number of works, notwithstanding the fact that the preservation of many of these is endangered by delay in binding.

RELATION OF THE LIBRARY TO AGRICULTURAL COLLEGES AND
EXPERIMENT STATIONS.

There are several ways in which the Department Library could be more closely related to the agricultural colleges and experiment stations than heretofore. This collection of books and pamphlets on agriculture and allied subjects being the largest in the country, and

containing many works too expensive for each agricultural college to buy, could be made more often available to special workers in these colleges. This class of workers should be the next to be benefited by the use of the Library after the employees of the Department, whenever it can be done without interference with the work of the Department. It would extend the usefulness of the Library, and it would be appreciated by those aided in their researches. Again, the duplicate copies of many publications which accumulate from year to year in all large libraries could be exchanged between this Library and the libraries of agricultural colleges and experiment stations to the advantage of both. A list of available exchanges will be issued by this Library at an early date for the purpose of furthering such exchanges. The request has come from agricultural colleges for suggestions concerning better methods in the administration of their libraries, and, if possible, for assistance in carrying them out. It would seem to be a legitimate function of the Library to have in training scientific aids who should be preparing to meet these requests. In addition to previous library training, such aids could become familiar with agricultural literature and gain experience that would enable them to organize an agricultural library and to continue its administration. Scientific aids, with the necessary qualifications, would also advance the work of the Library.

RECOMMENDATIONS.

The facility with which scientific investigations can be carried on in the Department depends very largely upon the completeness of the collection of books in the Library and its preservation and accessibility for ready use. In order to fulfill these requirements, and thereby meet the needs of the constantly increasing number of users of the Library in connection with the broadening fields of investigation, a larger appropriation should be made for the purchase of scientific books and periodicals; also a special appropriation is needed for binding current periodicals in the Library. An appropriation for scientific aids and such other assistants as shall advance the preparation of reference lists in connection with current work of the Department is a present need.

A most urgent matter for consideration is the provision for safer and more commodious rooms for the preservation and administration of the Library. This collection of 70,000 and more books and pamphlets is of exceptional value, and could not be duplicated for many years, if at all, and without a much larger expenditure of money than it has already cost. The delay to investigations from loss of any considerable part of the collection can not be estimated. In addition to the unsafe housing of the books, the accommodations for readers and for the work of the Library staff are crowded and inadequate. This crowded condition arises largely from the generally crowded condition of the Department, which necessitates the occupying of room in the Library for other than library purposes. I would, therefore, earnestly recommend that early consideration be given to these needs as set forth above, that the growth of the Library may be furthered, and thereby meet the demands of the expanding work of the Department.

REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., September 14, 1901.

SIR: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1901.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

DIVISION AND DEVELOPMENT OF WORK OF OFFICE OF EXPERIMENT STATIONS.

During the past year the work of the Office of Experiment Stations has continued to increase by the addition of new enterprises and the further development of those previously undertaken. Agricultural experiment stations, under the direct management of this Office, have been established in Hawaii and Porto Rico. Both the nutrition and irrigation investigations have been conducted on a larger scale than in previous years. The amount of material prepared for publication during the year has exceeded that for any similar period since the establishment of the Office. Unusual opportunities have been afforded for the study of the more general problems relating to the organization and development of agricultural education and research, and there is good reason for believing that along the lines already laid the Office may be able in the future to enlarge its usefulness in promoting these important interests. Besides closing up the work connected with the collective experiment station exhibit made at Paris, this Office has performed considerable labor in the remodeling of this exhibit and its installation at the Pan-American Exposition at Buffalo. With other expositions already in sight, it now seems likely that exhibit work may become a regular function of the Office, for which provision will have to be made in planning its operations from year to year.

To meet its new responsibilities, the organization of the Office has been extended in accordance with the plan previously adopted. The present division and assignment of the work of the Office are as follows: (1) Relations with American and foreign institutions for agricultural education and research, including the supervision of the expenditures of the agricultural experiment stations in the United States, in immediate charge of the Director; (2) the Experiment Station Record, in charge of the assistant director, Dr. E. W. Allen;

(3) Experiment Station Work and miscellaneous publications of the Office, in charge of Mr. W. H. Beal; (4) division of routine business, in charge of Mrs. C. E. Johnston; (5) Alaska Agricultural Experiment Station, in charge of Prof. C. C. Georgeson, with headquarters at Sitka; (6) Hawaii Agricultural Experiment Station, in charge of Mr. Jared G. Smith, with headquarters at Honolulu; (7) Porto Rico Agricultural Experiment Station, in charge of Mr. Frank D. Gardner, with headquarters at San Juan; (8) nutrition investigations, in charge of Prof. W. O. Atwater, with headquarters at Middletown, Conn.; (9) irrigation investigations, in charge of Prof. Elwood Mead. As hitherto, certain officers connected with the force at Washington, D. C., have been charged with promoting the interests of our more important outside enterprises as a regular part of their official business. Thus, Dr. C. F. Langworthy is our local representative for the nutrition investigations, and Dr. Walter H. Evans for the experiment stations in Alaska, Porto Rico, and Hawaii. With the development of the irrigation investigations it has been found necessary and desirable to transfer the headquarters of Professor Mead, the expert in charge, to Washington, D. C., leaving Mr. C. T. Johnston in charge of the station for the supervision of field work maintained at Cheyenne, Wyo.

As far as practicable the organization of the Office has been put on the same footing as that of other branches of the Department having complex functions. In this way the development of its organization has been made to conform to the prevalent movement within the Department, which has recently led to its partial reorganization under a bureau system. As it seems clear that this Office has become and is likely to remain one of the main divisions of the Department, it is only just that this fact should be formally recognized either by making it a bureau or by recognizing it as of equal rank with a bureau without changing its name.

As regards the future development of the Office, it seems to me desirable that its functions should be restricted for the most part to those of a kind of clearing house for the institutions for agricultural education and research at home and abroad, and to the management of the agricultural experiment stations directly maintained by the Federal Government. Its chief business should be (1) to study the general problems involved in the organization and management of various kinds of institutions for the discovery of new knowledge which may be applied to the benefit of agriculture and for the diffusion of such knowledge among our agricultural people, and (2) to col-
late for publication the results of the work of agricultural institutions at home and abroad. To this would naturally be added such administrative duties as Congress may devolve upon this Department relating to the supervision of national funds appropriated for the maintenance of agricultural experiment stations or to the direct management of such stations under Federal authority. In the past it has been deemed expedient to give this Office general supervision of certain special investigations which were to be carried on largely in connection with colleges and experiment stations. While administrative reasons may justify this procedure in some cases, it is not in my judgment desirable that this practice should be followed to an extent which would make the Office permanently responsible for the conduct of a considerable variety of such investigations. In view of the fact that questions relating to the reorganization of this Department are now being discussed, I desire to raise the question whether the time

has not already come for separating from this Office the important enterprise which has been organized within it as the irrigation investigations. These investigations are now well established and seem likely to be a permanent part of the business of this Department. In my judgment they form a sufficient basis on which to create a new bureau, corresponding to one of the great general divisions of agricultural science, namely, rural engineering. There are many problems connected with the laying out of farms and other rural estates, as well as parks, which this Department would do well to consider. Among these are questions relating to systems of drainage, water supply and sewage, terracing and other methods for preventing washing of land, landscaping, etc. Moreover, problems relating to farm buildings, implements, and machinery should be studied by the Department. In this country relatively little attention has thus far been given to agricultural engineering and many of its branches have hitherto been almost entirely neglected by this Department. I can not, however, see any good reason for further delay in taking up these important matters, and believe that an efficient Bureau of Rural Engineering would accomplish results of great usefulness.

By continuation of his detail to the Division of Botany, Dr. E. V. Wilcox completed his part of the investigation on the effects of poisonous plants on sheep feeding on the ranges of Montana and prepared a report thereon which has been published in Bulletin No. 26 of that Division. He also prepared an article on the same subject for the report of the Bureau of Animal Industry for 1900. During the present summer he has been detailed to the Bureau of Forestry to aid in conducting an investigation on the effects of grazing sheep in the forests of Wyoming. Mr. D. W. May was detailed for some time to the Division of Vegetable Physiology and Pathology, where, in connection with Dr. Loew, he made an investigation on the physiological relations of lime to magnesia in plant production, an account of which will appear in a forthcoming bulletin of that Division. Under advice of his physician, Mr. V. A. Clark felt compelled to change his residence from Washington, and after a short period of service in our irrigation office at Cheyenne, Wyo., he left our service, to our great regret. The irrigation investigations suffered a severe loss in the death of Col. E. S. Nettleton, whose service as an irrigation engineer in public and private capacities for many years had been an important factor in the establishment of the great irrigation system of the West.

The establishment of the experiment stations in Alaska, Porto Rico, and Hawaii, the broader and more intimate relations sustained with experiment stations in this country and abroad (now numbering in the aggregate about 800 stations and kindred institutions), and the enlargement of our efforts for the promotion of agricultural education have caused a material increase in the general business of the Office and necessitated the employment of some additional clerical and expert service. There is, moreover, considerable additional work imposed upon the Washington office in connection with the supervision of the stations in Alaska, Porto Rico, and Hawaii. To meet the necessities of this extra work the regular appropriation for the maintenance of this Office should be increased to \$35,000. In addition to this, I recommend an appropriation of \$5,000 be asked for to enable this Office to undertake the work connected with the promotion of the farmers' institute system in this country, as suggested on page 195 of this report.

RELATIONS WITH AMERICAN AND FOREIGN INSTITUTIONS FOR AGRICULTURAL EDUCATION AND RESEARCH.

The general features of the work of the Office involved in its relations with American and foreign institutions for agricultural education and research, in immediate charge of the Director, have remained essentially as heretofore and may be conveniently described under the following heads: (*a*) Agricultural experiment stations in the United States; (*b*) American institutions for agricultural education; (*c*) Association of American Agricultural Colleges and Experiment Stations; and, (*d*) foreign institutions for agricultural education and research.

AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

ADVISORY RELATIONS WITH THE STATIONS.

The functions of this Office in its advisory relations with the stations in the different States and Territories continue to grow in importance and to involve a larger amount and variety of work. The importance attached to the advice and assistance of this Office in many matters relating to the business of the stations is shown not only by an increase in the correspondence on these subjects, but also by more frequent calls for personal conferences between station officers and representatives of this Office. Through the regular annual visitation of the stations, the meetings of the Association of Agricultural Colleges and Experiment Stations, and the increasing number of visits of station officers to this Department the relations between this Office and the stations are becoming more and more intimate. While this makes it necessary to devote a larger amount of time and energy to this branch of our work, it is believed that the importance of the service thus rendered fully justifies all the attention given to it. Indeed, it would undoubtedly be still more profitable if more time could be given to visiting the stations and studying the problems which they respectively have to meet. In particular, recent experience has shown that it would be well if the representatives of this Office could come into closer touch with the governing boards of the stations.

If an arrangement could be made by which a representative of the Office could attend at least one meeting of the board of control in each State and Territory each year, it is believed that much good might result. This could not, however, be accomplished without an arrangement of our business which would involve the devotion of considerably more time than is now taken for the visitation of the stations. This would carry with it some addition to our working force. As it is, the boards of control of a considerable number of our stations are not thoroughly acquainted with the views of this Department regarding the management of the stations, and do not clearly understand the relations of the individual stations to the system of agricultural research in this country. This is a great hindrance to the progress of our stations and at present constitutes one of the most serious difficulties in their management.

With a view to bringing out more clearly the results of experience in the planning and conducting of different lines of station work, this Office proposes to take up from time to time special features of station work and make a report thereon, which will bring out the different methods of operation pursued at different stations. For example, data are now being collected respecting the operations of the stations

in plant production (agronomy), which will show the extent of such operations at the different stations as well as the methods pursued in this line of work. It is hoped that such a comparative view of these subjects will be useful in promoting more careful planning of work, more thorough study of methods, and a better correlation of the work of the different stations. Many of our most efficient station officers are convinced that much more attention should be given to the correlation of station work, with a view to the prevention of duplication and the promotion of a more systematic method of attacking agricultural problems. Without doubt there is here an opportunity for the profitable extension of the operations of this Office, but this can not be done without some increase in its resources.

In some ways the past year has been a notable one in the progress of agricultural research in this country. The results of practical importance already attained have inspired the public with such confidence in the value of this kind of investigation that Congress and the State legislatures have been unusually liberal to this Department and the experiment stations. At the same time business enterprises requiring scientific and expert knowledge and skill for their most successful management have been unusually prosperous. The managers of these enterprises have awakened to a much clearer appreciation of the value of the services of such men as are most successful workers in our institutions in agricultural education and research. An increasing number of our best workers in these institutions have therefore been given very attractive offers from the business world. So many public and private positions for well-trained and experienced workers in agricultural science and research have been opened that in some lines the demand has outrun the supply. This has led to numerous changes in the personnel of our experiment stations, partly through the transfer of their officers to outside enterprises, and partly through the change of officers from one station to another on account of differences in salary and other attractions. This is a remarkable state of things, considering the length of time during which our stations have been in operation, and brings them face to face, in a measure, with the same difficulties which attended their earlier operations when, for different reasons, there was an inadequate supply of trained workers. Without doubt the enterprise of agricultural research in general has been much strengthened by this recent development, but boards of control would do well to remember that frequent changes of officers inevitably weaken a station's operations and that they can not well afford to let thoroughly efficient workers go, especially in cases where small increases in salary or other comparatively trifling inducements would hold them.

As the work of the experiment station makes a more definite impression upon the public mind and is more clearly differentiated from that of the agricultural college as a whole, the State legislatures are called upon to make special appropriations for investigations by the stations. A notable example of this was the action of the recent legislature in Illinois, which appropriated \$46,000 for the next two years to be expended as follows: Experiments with corn, \$10,000; soil investigations, \$10,000; investigations in horticulture, \$10,000; experiments in stock feeding, \$8,000; dairy experiments, \$5,000, and sugar-beet experiments, \$3,000. This is in line with the development of the stations as distinct departments of the agricultural colleges. As such, the stations are, without doubt, entitled to definite recognition in the budgets of these institutions. A number of States have

recognized the value of the experiment stations by appropriations for substations. It is still, however, an open question whether appropriations for special investigations which may be conducted in different localities, according to circumstances, would not be more advantageous to agriculture than local substations.

There has recently been good progress in the recognition of the experiment station as a distinct unit within the college by the provision of separate buildings or parts of buildings for the exclusive use of the station. In Nebraska a building costing \$35,000 has been erected for the use of the experiment station. At the Louisiana State station a new laboratory building has been devoted exclusively to station purposes. In Pennsylvania a separate building for investigations on animals with the respiration calorimeter has been erected. In Alabama a new analytical laboratory has been provided for the station. In Illinois, Michigan, Mississippi, Oklahoma, Tennessee, Texas, and Kansas separate offices and laboratories for the station have been reserved in buildings erected for the use of the college. In this way material additions have been made, the facilities for station work in a number of States have been improved, and the importance of the station as a distinct department of the college has been greatly enhanced.

During the past year the office of director of the station has been separated from that of president of the college or university in four States—Colorado, Kansas, Nebraska, and North Carolina. In New Mexico and Tennessee, where the president retains the directorship, a vice-director has been appointed to have general charge of station business. In South Dakota the president of the college has recently been made acting director of the station, but it is understood that this is only a temporary arrangement pending the election of a new director. In eleven States and Territories the college president at present performs the functions of director of the experiment station.

In a number of instances newly appointed officers of the experiment stations have no duties as teachers in the college, and in other instances changes have been made by which the amount of teaching required of station officers has been materially reduced. Experience is each year showing more conclusively that if station officers are to accomplish the best results in agricultural investigations their research work must be made their primary business, before which routine duties of every kind must give way as the conditions of the original work demand. Our most successful stations are now managed on the principle that they constitute university departments of the colleges, that they are thus at the summit of our system of agricultural education, and that they must be managed on the same principles as the great scientific laboratories in the universities are conducted, that is, their officers must be the best-trained experts in their respective lines, and they must be able to devote their time and energy quite fully to their investigations. They should not be expected to do any considerable amount of teaching, especially in the elements of the sciences. If they go into the class room at all, it should be rather to lay before advanced students the methods and results of the investigations which they are conducting. Undoubtedly, the financial exigencies of many of our agricultural colleges will for some time prevent the attainment of this ideal in station management, but we may reasonably expect that wherever increases in the resources of these institutions will permit, changes in this direction will be made in the management of the stations.

SUPERVISION OF EXPENDITURES.

The sixth annual examination of the work and expenditures of the agricultural experiment stations which receive the National funds appropriated under the act of Congress of March 2, 1887 (Hatch Act), with special reference to the fiscal year ended June 30, 1900, was made during the past year in accordance with the authority conferred upon the Secretary of Agriculture by Congress, and a report of this investigation was prepared for transmission to Congress, as required by law. This report was published as House Doc. No. 336 (Fifty-sixth Congress, second session), and a special edition was issued as Bulletin No. 93 of the Office of Experiment Stations and distributed to the governing boards and officers of the stations.

As heretofore, the report was based upon three sources of information, viz, the annual financial statements of the stations, rendered on the schedules prescribed by the Secretary of Agriculture in accordance with the act of Congress; the printed reports and bulletins of the stations, and the reports of personal examinations of the work and expenditures of the stations made during the year by the Director, assistant director, and one other expert officer of the Office of Experiment Stations. The stations in all the States and Territories have been visited since the previous report was transmitted to Congress.

The following statements, taken from the report, indicate the general condition of the stations, especially in relation to the terms of the Hatch Act and the appropriation by Congress under that act:

The work of the stations as related to practical agriculture.—In making our examination of the work of the experiment stations during the past year we have particularly inquired whether their operations are conducted with special reference to the agricultural needs of their respective States and Territories. The results of this inquiry are embodied in the accounts of the individual stations given in this report. From these it will be seen that by far the largest part of the work of our stations has direct relation to the important agricultural interests of the communities in which they are located. The stations are, in fact, very responsive to the immediate demands of their farmer constituencies. Their greatest danger is not that they will undertake too much work of remote practical bearing, but that in the effort to meet the calls made upon them for immediate assistance they will attempt individually to cover more fields of investigation than the funds at their disposal will permit them to treat thoroughly. This temptation the stations generally are, however, resisting more successfully as their work is becoming better organized and their investigations are more carefully planned and supervised. The nature of their operations is also becoming better understood by the farmers, and the desirability of more thorough and far reaching investigations is much more appreciated than formerly. A broader and deeper foundation of scientific inquiry is being laid each year, and there is a constant accumulation of data regarding the general agricultural conditions of the different regions of the United States. The climate, soil, water supply, native and cultivated plants, injurious insects, fungi, and bacteria are being studied in more detail and with greater thoroughness than ever before. The principles of nutrition of animals and the causes of their diseases are being subjected to more elaborate and fundamental scrutiny. Methods of investigation and the improvement of apparatus for research are being given increased attention. Much of this work is done without public observation and in the intervals of other operations. Without doubt it should receive more definite recognition and encouragement. But it is a cause for congratulation that so much patient labor of this character is being performed by station officers, who, as a rule, are seeking to advance the boundaries of knowledge for useful ends and are not deterred by a multiplicity of duties from giving attention to the more fundamental concerns of agricultural science. And this work is having its effect on the more practical operations of our stations. There are assuming a more substantial and systematic character and are being conducted with more definite relation to actual conditions. They have, therefore, a greater assurance of successful practical outcome. Questions relating to the introduction of plants or to the improvement of the live-stock industry in any region, for example, are now being investigated with a strict relation to the real requirements

of the agriculture of that region, which would have been impossible a few years ago. The present activity in plant breeding, as distinguished from the indiscriminate testing of varieties, is a good example of the raising of the level of experimentation work as applied to directly practical ends. The plant breeder now sets definitely before him the kind of variety needed by the farmer in a given region or for a given purpose and applies all his scientific knowledge and practical skill to the production of such a variety. The notable success of some of the efforts in this direction already made are but a foretaste of much wider practical results as knowledge and experience in this line of endeavor increase. To do such work effectively there must be an almost ideal combination of science and practice. And the more we can learn definitely regarding the underlying principles the more surely will we be able to make successful practical applications. In such investigations science becomes more practical and art more scientific.

Problems of station organization.—Much attention has been given during the past year to questions relating to the more perfect organization of the stations. As the stations develop, the importance of a clearer definition of the functions of different officers in administration and investigation becomes more apparent. Conditions which existed when institutions for higher education and research were established in this country have materially changed, and the old forms of organization are now, in many cases, a serious hindrance to their best development. For example, the theory on which the laws relating to the governing boards of many of the State colleges and experiment stations are based is that the board is to have the direct control and management of the institution. For this purpose it is to meet frequently, keep the details of the business of the institution well in hand, consult freely with officers of various grades, and pass rules and regulations governing every operation. This may, perhaps, have been well enough when the institutions were in a formative period and trained executive officers were scarce, but to day this theory is out of date, and its application to the intricate and specialized business of our colleges and stations is highly injurious to their best interests. It works just as badly when applied to a college or experiment station as it would in the case of a railroad or a bank. The fact is that boards of control are most useful when their functions are confined to a broad, general supervision of the policy, finances, and work of the institution and the choice of its chief officers. For this purpose annual or semiannual meetings would ordinarily be sufficient, since the number of matters requiring the attention of the board should be reduced to a minimum. The best reason for the continuance of such boards is that when composed of broad-minded and successful citizens they represent the best sentiment of the community regarding these institutions, and are able to give the public an adequate guaranty for the wise and liberal management of the great interests involved in the State colleges and universities. Otherwise it would probably be best to do away with the boards and make the heads of the colleges directly responsible to some State officer of high rank. One especially annoying and unjustifiable feature of the present system is the maintenance at many of the colleges of an officer, commonly designated secretary of the board, who acts as a representative of the board in the intervals between their meetings and exercises important functions relating to the business of the institution independently of its president. There is thus divided responsibility in the daily administration, and in case of friction between the president and faculty or students often a convenient center for discontent and disloyalty is ready at hand. All the legitimate functions of a secretary of the board might easily be performed by a registrar or other officer attached to the president's office, and thus an important "rock of offense" might be removed from the administrative system of these institutions.

The successful college president is no longer preeminently a great scholar, but rather a broad-minded and well-trained man of affairs, understanding the requirements of modern educational and scientific institutions and able to administer the affairs and manage the personnel of such institutions. He will look to his governing board for advice and counsel on the larger matters of general policy, but he ought not to have their intervention in the details of the business. To his hands should be fully committed the administration of the whole institution, and his work should be judged with reference to its successful issue. There should be no doubt in the mind of any officer connected with the institution that he is responsible to the president for his official conduct, and that an appeal to the board can be made only in extreme cases.

The institution will naturally be divided into a limited number of departments, at the head of each of which will be placed an officer competent to plan and manage the business of the department intrusted to his charge. The amount and character of the administrative duties which these officers will be called upon to discharge will vary with the nature of the department. The agricultural experi-

ment station is by law to be organized as a department of the college with which it is connected. It differs from the ordinary college department in being charged with the work of investigation rather than instruction and in having definite relations with a great industry for whose promotion it is especially established. Through its correspondence, publications, inspection service, and association with the farming community it has an increasing amount of business not immediately relating to its investigations, but requiring special knowledge and skill for its successful discharge. To do most effective work the operations of the station proceed in accordance with a well-matured plan which involves the cooperation of different members of the staff. So extensive and important has the business of the stations become that their proper management requires the time and energy of an executive officer, or director. In some cases it may still be possible for the director to conduct investigations in some special line or do a limited amount of teaching, but as a rule he can do little beyond attending to administrative duties. In a number of institutions prudential reasons of various kinds have led to the combination of the offices of president and director. Whatever justification there may have been for this in the past there is little excuse for it in the present. The duties of a college president are too multifold and onerous to permit his giving much attention to the special needs of an experiment station. His directorship almost necessarily becomes a nominal affair and the general business of the station is actually performed by some one member of the staff or distributed in a desultory way among a number of subordinate officers. This arrangement has not worked well and should be universally abandoned.

As regards the business of the station, the director should be clothed with a large measure of authority and consequent responsibility, should plan and supervise its work and expenditures, and control its staff to such an extent as will bring them together to work as a unit for the promotion of the station's success. The members of the staff should be directly responsible to the director on all matters relating to the station, whatever their position may be in other departments of the college, and should expect to transact station business through the director rather than through the college president or the governing board. A proper independence in the conduct of investigations, or parts of investigation, in their respective specialties and just credit for their share in the station's operations as set forth in publications or otherwise may, it is believed, be amply secured for the expert officers of the stations at the same time that good discipline is maintained and ample provision made for united effort.

No class of men need to readjust their professional code to the modern requirements of the organization of great scientific and educational enterprises more than college professors and scientific specialists. A way must be found by which teaching and research can be conducted on a system which combines liberty with law. The old régime of the entirely independent teacher and investigator has passed away. The specialization which is simply a form of the division of labor well known in industrial pursuits carries with it a necessity for combination of workers in educational and scientific institutions, as well as in manufacturing establishments. In a way hitherto unknown, scientific men will be called in the future to work together for common ends. No matter is of more vital importance in the organization of our colleges and experiment stations than the securing of harmonious and concerted action on the part of faculties and staffs for the common good of the institution to which they are attached. (One of the greatest difficulties now attending the successful management of these institutions is the fact that while specialization has narrowed the field and outlook of the individual officer, there has not been a corresponding recognition of the necessity of readjusting the form of organization and the spirit of the worker to meet these new conditions. At no time has there been greater need of the cultivation of an earnest and enthusiastic esprit du corps among the rank and file of educational and scientific workers. There are many individual examples of men impressed with this lofty sentiment, but the whole body is not yet animated with it. Obviously, it should especially be a virtue characteristic of men connected with public institutions. The officers of our agricultural colleges and experiment stations are public functionaries employed to advance very important public interests. With them the good of the community, as involved in the success of the enterprise with which they are connected, should be the ruling motive of action. The fame and emoluments of the individual worker should be subordinated to the requirements of concerted action for a common end. And yet in the long run it is believed the individual worker as well as the institution will profit by a loyal and self-sacrificing discharge of common duties, for union of effort will bring greater success, and whenever a college or a station is strong and flourishing, credit is reflected on every worker who has contributed to this issue.

The general considerations affecting the efficient organization of our experiment stations have thus been dwelt upon because a survey of these institutions during the past year has brought additional evidence that the problems of organization are being more generally considered than ever before. The tide is running strongly toward a more compact organization and a greater unification of the work. On the whole, those stations which have a strong organization and administration are meeting with the largest measure of success.

The original work of the stations.—There is also unusual interest in the discussion of problems relating to the functions of the stations and the specific duties of station officers. There is quite general agreement that each station should conduct a considerable amount of original investigation; but in what way this should be provided for and what should be its character are variously regarded. There is still great variety in the assignments of teaching and investigation to officers in different stations, and the relative amount of work of research which is left to assistants differs very greatly in different places. Considerations relating to the financial conditions of college and station still affect the assignment of work in a number of institutions. Our observation of the situation leads us to the belief that there is actually going on a widespread differentiation of the investigator from the teacher, and that this is not prevented, though it may be hindered, by the varying arrangements made at the colleges and stations. A certain number of men are more and more devoting themselves to the work of investigation and succeeding in it. Others are just as certainly losing their interest and activity in such work. Because a man is required to teach many hours he does not thereby become a successful teacher. The research which he is compelled to carry on during vacations and at night may nevertheless be his real mission, and it will be well if his superiors discover this. The leaving of details of research work to assistants often means that the principal has largely lost his interest in it or considers other duties more important. We are getting an increasing body of competent investigators by this process, though in too many cases their training is proceeding under untoward conditions. It will be well if boards and presidents will consider more fully the actual state of things and make, as far as possible, such a readjustment that the investigator will be left very largely to investigate and the teacher to teach. It continues to be a weakness of a considerable number of our stations that they are organized on too broad a scale for their resources. Too great a portion of their funds is going into salaries, leaving too little to pay the miscellaneous expenses of important investigations. Here and there only have the authorities had the wisdom and courage to confine the operations of the station within comparatively narrow lines, leaving important departments of work entirely without recognition. It is encouraging, however, to observe that where this has been done success has brought additional funds with which the scope of the station's work could be safely extended.

On the whole, the amount of what may fairly be called original investigation is, in our opinion, steadily increasing. To determine this it is not sufficient to consider simply the bulletins of the stations. These have in various ways been made more popular in form and matter. A large amount of the more original work is being recorded in the annual reports and the records of more investigations are being withheld from publication until results of value are obtained. While there is still need of urging the advancement of the general standard of investigations, there is every reason to believe that our stations are moving onward and upward as agencies for the original investigation of agricultural problems.

The inspection service of the stations.—The amount and variety of inspection service required of our experiment stations continue to grow from year to year. Beginning with commercial fertilizers, it now includes feeding stuffs, dairy products and other foods for man, creamery glassware, insecticides, nursery stock for injurious insects, and plant and animal diseases. For a considerable period this matter affected only the stations in the East, where commercial fertilizers were largely used, but it is now a live question in all sections of the country, since there is no region which does not have some evil against which the agricultural public is demanding protection by inspection under State or National auspices. Questions relating to the attitude of the stations toward this work are therefore engaging the attention of station officers throughout the country. Wherever this work has assumed considerable magnitude it is evident that it requires very careful organization in order that it may be conducted so as not to interfere with the work of investigation. Where the same officers are charged with both kinds of work there is constant danger that the severe routine duties of the inspection service will diminish the ability of these officers to conduct thorough original investigation. It is essential that there should be a distinct differentiation of this service from the other work of the stations as regards both funds and time of

performance. Unless this is done and close supervision is exercised, the inspection work is inevitably a drain upon the resources of the station and a hindrance to its more important operations.

While our stations have from the beginning been engaged in inspection work, and this has met with increasing popular favor because of its efficient performance, it is still doubtful whether it is the best ultimate arrangement. Almost all our experiment stations are organic parts of educational institutions. As such they are essentially university departments devoted to research and the dissemination of new knowledge. To a certain extent they may naturally and properly engage in the various forms of university extension work through their more popular publications and connection with farmers' institutes, etc. They are organized to conduct investigations on a great variety of subjects, and the scope of their work of investigation can be almost indefinitely extended as their funds increase. They do not need, therefore, to go outside of that work which would be universally considered within their rightful domain as departments of colleges and universities in order to secure a wide field of operation. On the other hand, as the range of inspection service enlarges and its duties become more onerous and complicated it becomes very questionable whether this service should be connected with our educational institutions. It is essentially a part of the police functions of the State and National governments. It involves many questions on which sooner or later the courts will have to pass. It may even excite public attention to such an extent as to be reckoned worthy of consideration by the people in their choice of administrative and legislative officers. In many ways this kind of business is much more appropriate to bureaus of the State government than to educational institutions.

Thus far the arrangement by which much of it has been connected with the experiment stations has been largely a matter of convenience, and in many States the amount of work to be performed has been so inconsiderable that it has not seemed worth while to create special agencies for its performance. We have now reached a stage in the development of this work when it is believed that this matter should receive careful attention from the managers of our agricultural colleges and experiment stations, in order that a sound policy may be established which will provide for the best future development of these institutions. In our judgment this would involve efforts to relieve the colleges and stations of the inspection service rather than to increase its scope at these institutions and make it a permanent portion of their work.

Statistics of the stations.—Agricultural experiment stations are now in operation, under the act of Congress of March 2, 1887, in all the States and Territories. As stated elsewhere in this report, agricultural investigations in Alaska have been continued with the aid of National funds; an experiment station under private auspices is in operation in Hawaii; and Congress has appropriated \$10,000 for the establishment and maintenance of an experiment station under Government auspices in Hawaii and \$5,000 for a preliminary study of questions relating to the establishment of an experiment station in Porto Rico. In each of the States of Connecticut, New Jersey, and New York a separate station is maintained wholly or in part by State funds; in Louisiana three stations are thus maintained; and in Alabama two—the Canebrake and Tuskegee stations—are maintained wholly by State funds. Excluding the branch stations established in several States, the total number of stations in the United States is 57. Of these, 52 receive appropriations provided for by act of Congress.

The total income of the stations during 1900 was \$1,170,857.78, of which \$719,999.07 was received from the National Government, the remainder, \$450,858.71, coming from the following sources: State governments, \$217,281.46; individuals and communities, \$2,420.51; fees for analyses of fertilizers, \$70,927.31; sales of farm products, \$90,088.84; miscellaneous, \$40,140.59. In addition to this, the Office of Experiment Stations had an appropriation of \$45,000 for the past fiscal year, including \$12,000 for the Alaskan investigations. The value of additions to the equipment of the stations in 1900 is estimated as follows: Buildings, \$89,416.23; libraries, \$10,784.70; apparatus, \$19,397.55; farm implements, \$17,015.86; live stock, \$22,009.10; miscellaneous, \$8,850.94—total, \$167,474.68.

The stations employ 693 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 71; chemists, 143; agriculturists, 74; experts in animal husbandry, 14; horticulturists, 75; farm foremen, 24; dairymen, 30; botanists, 55; entomologists, 50; veterinarians, 29; meteorologists, 16; biologists, 6; physicists, 7; geologists, 6; mycologists and bacteriologists, 17; irrigation engineers, 7; in charge of substations, 10; secretaries and treasurers, 7; librarians, 10, and clerks, 51. There are also 30 persons classified under the head of "miscellaneous," including superin-

tendents of gardens, grounds, and buildings, apiarists, herdsman, etc. Three hundred and twenty-seven station officers do more or less teaching in the colleges with which the stations are connected.

The activity and success of the stations in bringing the results of their work before the public continues unabated. During the year they published 386 annual reports and bulletins, which are many more than are required by the Hatch Act. These were supplied to over half a million addresses on the regular mailing lists. A number of stations supplemented their regular publications with more or less frequent issues of press bulletins. These are short popular articles which are prepared at little expense to the station, but which, through the medium of the local agricultural press, reach a wide circle of readers and bring the station and the practical results of its work pointedly before the public.

The stations are being consulted more and more by farmers, and the information given is of the most varied character. This necessitates a voluminous and constantly increasing correspondence. Station officers come into personal contact with farmers at farmers' institutes, where they make addresses and answer questions. Many persons are thus benefited by the stations' work who would not otherwise be reached.

The results of station work are further given wide publicity by the general agricultural press. These papers not only give numerous popular accounts of the work of the stations, but they often employ station officers to answer questions of correspondence and as special contributors. Station officers are also frequent contributors to scientific journals. A number of books by station officers has been published during the year.

COOPERATION OF THE STATIONS WITH THE DEPARTMENT.

The number and variety of cooperative enterprises between the different Bureaus and Divisions of this Department and the experiment stations have been greatly increased during the past year. Much progress has also been made in determining the principles on which successful cooperation must be based and the best methods of arranging and conducting such operations. Experience has shown the desirability of a thorough preliminary discussion of the cooperative plans and the final making of a definite formal contract for the work to be actually undertaken. It has also been made clear that such contracts should be made through the directors of the stations and the officers of this Department having general responsibility for the work to be undertaken. The plan which is now generally followed in arranging for cooperation is substantially as follows:

Through preliminary correspondence or personal conferences the officers of the Department and the stations immediately concerned in the proposed cooperative enterprise discuss the terms of cooperation, with the understanding that their action is in no way binding on either the Department or the station. When the plan of cooperation has thus been devised a tentative contract is drawn which is submitted to the director of the station and the chief of the Bureau or Division of the Department having general charge of the work. After the contract is reduced to a form satisfactory to both these parties it receives their signatures, and is then submitted to the Secretary of Agriculture and becomes effective through his approval. It is understood, however, that as far as this Department is concerned no actual operations will be begun under such a contract until the proper commissions and letters of authorization for the expenditure of funds have been issued by the Department in the usual form. Copies of these contracts are filed in this Office as well as in the offices of the contracting parties. This Office also keeps a record of all cooperative enterprises between the Department and the stations and aids the officers of the Department and stations in arranging the details of the cooperative agreement whenever its assistance is sought. Whenever new enterprises

are undertaken there are, of course, many details which have to be worked out for each case as it arises, and no general rules can be devised which will cover all such matters, but with the general principles and methods well established there is, as a rule, comparatively little difficulty in arranging the details of cooperation.

Without doubt great progress has recently been made in bringing the Department and the stations into closer touch, and through their cooperation important investigations for the benefit of agriculture in many parts of the country have been greatly strengthened. The records of this Office show that the Department is at present cooperating with the stations in 43 States and Territories. Among the subjects on which cooperative investigations are being conducted are the following:

Tests of varieties of grasses and forage plants in many localities; special experiments with grasses and forage plants for the arid region and the improvement of range lands; breeding experiments with plants, especially cereals; experiments with hybrid orange trees; the culture of sugar beets, dates, and tobacco; planting forest trees; the nutrition of farm animals and man; the gluten content of wheat; plants poisonous to stock; soil investigations; injurious insects, especially the codling moth and locust, and irrigation investigations.

The following is a list of the cooperative enterprises between the Department and the stations as at present recorded in this Office. Besides the more formal enterprises which involve the expenditure of more or less money on both sides, this list includes a number of minor operations for which no formal contracts have been made:

Summary of cooperative enterprises between the Department and the stations.

Station.	Bureau, Office, or Division.	Line of work.
Alabama	Plant Industry	Hybridization of orange trees.
	Chemistry	Potash—methods of analysis.
Arizona	Plant Industry	Plant breeding.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Plant Industry	Improvement of desert ranges.
	Plant Industry	Culture of dates.
	Soils	Alkali-soil investigations and soil mapping.
California	Experiment Stations	Irrigation investigations.
	Chemistry	The gluten content of wheat.
	Chemistry	Soils—methods of analysis.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Plant Industry	Planting and testing of sand-binding plants.
	Experiment Stations	Nutrition investigations.
Colorado	Entomology	Codling moth.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	The gluten content of wheat.
	Forestry	Tree planting.
	Plant Industry	Forage crops for alkali and arid soils.
Connecticut (State) ..	Soils	Tobacco investigations.
Connecticut (Storrs) ..	Experiment Stations ..	Nutrition investigations.
Delaware	Chemistry	Influence of environment on the sugar content of muskmelons.
	Plant Industry	Cover crops for orchards.
Florida	Chemistry	Food analysis of pineapples.
	Chemistry	Phosphoric acid—methods of analysis.
	Plant Industry	Hybridization of orange trees.
Georgia	Plant Industry	Hybridization of orange trees.
Idaho	Entomology	Codling moth.
Indiana	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	The gluten content of wheat.
	Chemistry	Sugar-beet investigations.
Iowa	Chemistry	Sugar-beet investigations.
Kansas	Plant Industry	Pasture and range improvement.
	Forestry	Tree planting.
	Plant Industry	Improvement of cereals, etc.

Summary of cooperative enterprises, etc.—Continued.

Station.	Bureau, Office, or Division.	Line of work.
Kentucky	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	The gluten content of wheat.
Louisiana	Chemistry	Sugar-beet investigations.
	Entomology	Certain grasshopper outbreaks.
Maine	Plant Industry	Hybridization of orange trees.
	Plant Industry	Plant breeding.
Maryland	Experiment Stations ..	Nutrition investigations.
	Plant Industry	Cereal investigations, and a varietal test of sweet potatoes.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	The gluten content of wheat.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Best crops for use in securing a continuous soil- ing series for dairy and farm stock.
Michigan	Soils	Chemical study of soils, and soil survey.
	Chemistry	The gluten content of wheat.
	Chemistry	Sugar-beet investigations.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Best grasses for fixing drifting sands.
	Soils	Cooperation to a certain extent in the selection of areas and regarding base maps.
Minnesota	Forestry	Tree planting.
	Plant Industry	Improvement of wheat industry of the North west.
Mississippi	Experiment Stations ..	Nutrition investigations.
	Chemistry	Nitrogen—methods of analysis.
Missouri	Chemistry	The gluten content of wheat.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Formation and management of meadows and pastures.
	Experiment Stations ..	Irrigation investigations.
Montana	Plant Industry	Stock-poisoning plants of Montana.
	Forestry	Tree planting.
Nebraska	Experiment Stations ..	Irrigation investigations.
	Plant Industry	Cultivation and improvement of native grasses.
	Forestry	Tree planting.
	Plant Industry	Determination of the effects of influence of environment on plants.
	Entomology	Injurious locusts.
	Entomology	Injurious grasshoppers and grasshopper fungus disease.
Nevada	Experiment Stations ..	Irrigation investigations.
	Experiment Stations ..	Irrigation investigations.
New Hampshire ..	Plant Industry	Improvement and renovation of worn-out hay and pasture lands.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
New Jersey	Chemistry	Insecticides—methods of analysis.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Experiment Stations ..	Irrigation investigations.
	Soils	Cooperation in the selection of areas and regarding base maps.
New York State	Chemistry	Dairy products.
	Chemistry	Sugar-beet investigations.
North Carolina	Soils	Soil survey and the establishment of test farms.
	Chemistry	Ash—methods of analysis.
	Chemistry	Influence of environment on the sugar content of muskmelons.
	Chemistry	Sugar-beet investigations.
	Plant Industry	Varietal test of sweet potatoes and hybridization of orange trees.
North Dakota	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Improvement of wheat industry of Northwest.
Oklahoma	Forestry	Tree planting.
Oregon	Plant Industry	Best grasses for fixing drifting sands.
	Plant Industry	Stock-poisoning plants of Oregon.
	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Animal nutrition, involving the construction of a respiration calorimeter.
Pennsylvania	Animal Industry	Animal nutrition, involving the construction of a respiration calorimeter.
South Dakota	Forestry	Tree planting.
	Plant Industry	Renewing of worn-out pasture lands, etc.
Tennessee	Plant Industry	Influence of origin of red clover seed on yield of crop.
	Plant Industry	Formation and management of meadows and pastures.

Summary of cooperative enterprises, etc.—Continued.

Station.	Bureau, Office, or Division.	Line of work.
Texas.....	Plant Industry.....	Best and most practical ways for the formation of meadows and pastures.
	Forestry.....	Tree planting.
	Chemistry.....	Influence of environment on the sugar content of muskmelons.
	Plant Industry.....	Improvement of wheat industry in Middle States of the Great Plains.
	Entomology.....	Mexican cotton-boll weevil.
Utah.....	Soils.....	Selections of areas.
	Experiment Stations..	Irrigation investigations.
	Chemistry.....	Sugar-beet investigations.
	Forestry.....	Tree planting.
	Plant Industry.....	Grasses and forage plants for arid and alkali soils.
Vermont.....	Soils.....	Alkali soils, seepage, and drainage investigations.
	Experiment Stations..	Irrigation investigations.
	Experiment Stations..	Nutrition investigations.
	Chemistry.....	Methods of manufacture of cider.
	Chemistry.....	Sugar-beet investigations.
Washington.....	Soils.....	Soil survey.
	Plant Industry.....	Improvement of the Northwestern ranges.
	Entomology.....	Insects injurious to forests.
West Virginia.....	Chemistry.....	Sugar-beet investigations.
Wisconsin.....	Plant Industry.....	Influence of origin of red clover seed on yield of crop.
	Experiment Stations..	Irrigation investigations.
Wyoming.....	Plant Industry.....	Grasses and forage plants for alkali soils.
	Plant Industry.....	Plant breeding.
	Experiment Stations..	Irrigation investigations.

EXPERIMENT STATION EXHIBIT AT THE PARIS EXPOSITION OF 1900.

The collective experiment station exhibit at the Paris Exposition of 1900, made under the general supervision of a committee of the Association of American Agricultural Colleges and Experiment Stations, working in cooperation with this Office, was described in my report for 1900. At the close of the exposition this exhibit was packed for shipment under the supervision of Mr. J. I. Schulte, of this Office, and arrived in this country in good condition.

EXPERIMENT STATION EXHIBIT AT BUFFALO PAN-AMERICAN EXPOSITION OF 1901.

The experiment station exhibit made at the Paris Exposition was transferred to Buffalo in the spring of 1901 and with some additions was installed at the Pan-American Exposition. Owing to the limited amount of space in the Government building available for the exhibits of this Department, only that portion of the experiment station exhibit which illustrated the functions of this Office was installed in the Government building. By the courtesy of the general officers of the Pan-American Exposition the remainder of the station exhibit was placed in the agricultural building, where it was located in immediate conjunction with the exhibits made by the New York State and Tennessee experiment stations. In this way the different functions of our experiment stations were more fully illustrated. A considerable amount of work was done by this Office in remodeling the Paris exhibit and installing it at Buffalo. This work was in charge of Dr. C. F. Langworthy.

AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

THE COLLEGES.

Considerable progress has been made during the past year in broadening and strengthening the agricultural courses in these institutions,

The movement for the division of the general subject of agriculture into specialties to be taught by different instructors still continues. For example, the college of agriculture of the University of Illinois, having received additional financial support, has reorganized its agricultural course and added several members to its faculty, so as to divide the teaching of the different branches of agriculture among a number of specialists. The industrial college of the University of Nebraska has also introduced new courses in agronomy and animal husbandry and has established a department of dairy husbandry.

The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations, of which the Director of this Office is a member, has completed its syllabus for a college course in agriculture by presenting outline courses in agrotechny (especially dairying), rural engineering, and rural economics. Thus far comparatively little attention has been given to the two latter branches of agricultural instruction in our colleges. There is, however, good reason to believe that with the increase of the resources of these institutions more adequate courses in these important subjects will be provided. The beginnings of a movement in this direction are seen in the recent establishment of a department of irrigation at the University of California and the offering of a special course for irrigation canal superintendents and State water commissioners at the State Agricultural College of Colorado. Provision has also been made at the University of Wisconsin for a course of lectures on agricultural economics.

There has been a considerable increase in the total number of students attending agricultural courses in the colleges, but a great majority of these students are unwilling or unable to complete the four years' course leading to the bachelor's degree. There is an increasing demand for short and special courses, and the colleges are meeting this to a greater extent than heretofore. A much larger amount of college extension work in agriculture is now being done than ever before. In the States in which this work has been in progress for a number of years it is being continued, and many institutions in other States are following the example of the pioneers in this line of education. This work is also assuming a considerable variety of forms. The following are some recent examples of this tendency:

The Alabama Polytechnic Institute has begun the publication of short articles in local newspapers. The agricultural department of the State Agricultural College of Colorado has begun the publication of "Agricola Aridus," a bimonthly magazine for college-extension work; also of press bulletins. The faculty and staff of the Delaware college and station have begun giving nature-study lectures. The School of Agriculture of the Nevada State University has begun the publication of nature-study leaflets. The Rhode Island College of Agriculture and Mechanic Arts makes exhibits at county fairs, furnishes notes on the station for agricultural papers, sends members of its staff to visit prominent farmers, has inaugurated correspondence courses, and begun the introduction of nature study in rural schools. The State Agricultural and Mechanical College of the University of Tennessee has prepared a permanent exhibit for sending to meetings of farmers to illustrate the work of the station. The State Agricultural and Mechanical College of Texas has begun the publication of press bulletins and notes. The faculty of the West Virginia University have undertaken nature-study work. The North Dakota Agricultural College and Experiment Station have prepared instructive

exhibits for fairs in the State and also a number of permanent exhibits to be displayed in public places. Through the efforts of this college nature study is now being taught in all the training schools for teachers, and all the high schools of the State will offer courses in agriculture. The excursions to the college and station brought in about 1,700 farmers this year. The details of these excursions were all arranged by the director of the station, who obtained a merely nominal fare on the railroads and even planned the running of the excursion trains.

In providing for maintenance and new buildings at the agricultural colleges, the various State legislatures meeting during the past year have been more than usually liberal. At the last session of the Kansas legislature over \$200,000 was appropriated to the State Agricultural College for new buildings and other improvements and maintenance. Of this sum, \$70,000 will be expended in the erection of a new physics and chemistry building, and \$10,000 for additions to the library. The appropriations of the Minnesota legislature for its college of agriculture aggregate this year over \$90,000, of which \$25,000 will be used for a new chemical building, \$25,000 for a new veterinary building, \$12,000 for additions to the women's dormitory, and \$7,500 for instruction and experiments in curing meat. Colorado has provided \$40,000 for the erection of a new irrigation engineering building. The Michigan Agricultural College has recently completed a women's building costing \$95,000, a dairy building costing \$15,000, a barn costing \$4,000, and the State legislature at its last session provided for an annual levy of one-tenth mill on the taxable property of the State, which will yield \$100,000 per annum for the support of the agricultural college, experiment station, substations, and farmers' institutes. In North Dakota a levy of one-fifth mill on the taxable property of the State will provide additional funds for the maintenance of the agricultural college. A special appropriation of \$50,000 for buildings has also been made by the legislature. The College of Agriculture of the University of California has at its disposal \$250,000 per annum for two years. The legislature of Indiana has provided \$60,000 for a new agricultural building at Purdue University and \$10,000 a year for two years for maintenance and equipment of the same. The College of Agriculture and Mechanic Arts of the University of Missouri has been provided by the Missouri legislature with \$40,000 for a dairy and live-stock building, \$40,000 for a horticultural building and equipment, and other minor appropriations, making a total of over \$100,000 for the agricultural work of the university. At the New Hampshire College of Agriculture and Mechanic Arts \$30,000 provided by the legislature will be expended in the erection of an agricultural building. The Oklahoma assembly has levied taxes to raise \$46,000 for the construction of an engineering building and for additions to the library at the Oklahoma Agricultural and Mechanical College. Washington Agricultural College has an appropriation this year of nearly \$120,000; \$25,000 for a chemical building, \$10,000 for an armory, nearly \$25,000 for other improvements, and \$60,000 for maintenance. The South Dakota Agricultural College has an appropriation of \$40,000 for an engineering and physics building and \$10,000 for a building for work in plant breeding. The University of Idaho has received \$50,000 for a science hall and girls' dormitory. In Wyoming the legislature gave the State university \$36,000 for a science building. This institution is also receiving \$15,000 a year from the rent of its lands. In Montana a fund of \$16,000 has accumulated from the rent of lands belonging to the agricultural college.

The financial and statistical reports of the colleges receiving appropriations under the act of August 30, 1890, which in accordance with the law are regularly forwarded to the Secretary of Agriculture, have, as hitherto, been deposited in this Office. On the basis of these reports and replies to special circulars of inquiry, this Office has published statistics relating to the agricultural colleges for the year ended June 30, 1900. Reports for the fiscal year ended June 30, 1901, have now been received.

SECONDARY AND ELEMENTARY SCHOOLS.

One of the most hopeful signs to those interested in agricultural education is the effort on the part of the faculties of agricultural colleges and of others charged with the education of our youth toward the development and support of secondary agricultural schools and the introduction of nature study and elementary agriculture into the rural schools. Alabama continues to support nine Congressional district agricultural high schools, which annually accommodate about 2,000 pupils at a cost to the State of \$22,500. Minnesota has for a number of years supported a successful secondary school of agriculture in connection with the State university, and the legislature of 1901 appropriated \$2,000 a year for two years for the introduction of agriculture into the rural schools. The University of Nebraska has recently inaugurated a similar school of agriculture with a three-year course. A recent law in Wisconsin provides for the establishment of county agricultural high schools. In Missouri increased attention is being given to carrying out the provisions of the law requiring agricultural instruction in rural schools, and to prepare teachers for this work departments of agriculture have been established in the three normal schools of that State, located at Cape Girardeau, Kirksville, and Warrensburg. Through the efforts of the committee for the promotion of agriculture of New York a school of practical agriculture and horticulture has been put into successful operation at Briar Cliff Manor, N. Y.

In many States the problem of improving the rural schools is causing general discussion, and there seems to be a marked tendency toward concentration, that is, the elimination of small schools and the establishment of centralized schools, often with free transportation for pupils living at a distance from the schoolhouse. This movement has in several cases resulted in the establishment of rural high schools, with the township or the county as a unit. Reports coming from sections where centralization has been tried show for these schools better supervision, better teaching, better buildings and other facilities for instruction, better health and morals on the part of the pupils, more regular attendance, a longer continuance of the large boys and girls in school, and considerably enriched courses of study. These courses of study at the present time are in the formative state; they are merely outlined, or, at most, in the first years of experimental development. Means for improving them are eagerly sought and thoughtful suggestions receive careful consideration.

The time seems favorable, therefore, for the Department to take a more active part in encouraging the introduction of nature study and elementary agriculture into the curricula of rural schools, with the idea of developing the natural tendencies of the pupils to observe and take an interest in the natural phenomena surrounding them, and of fostering in them a love for the country and its pursuits. Such encouragement may be given by cooperating with departments of

education in the publication and distribution of suggestive courses of study and of a bibliography of works that would be helpful to teachers, by distributing seeds and plants for use in establishing school gardens, by furnishing schools with collections of specimens of beneficial and injurious insects, plant diseases, and other illustrative material, by supplying teachers with the publications of this Department which would be useful to them, and by such other means as would suggest themselves as the work progressed. The Department might also do much to promote the great movement for the betterment of country life by timely articles on this subject in its Yearbook and other popular publications.

FARMERS' INSTITUTES.

As the work of the experiment stations has developed it has become very evident that in addition to their publications there is needed a thorough system for the prompt and efficient dissemination of their results directly to the farmers through oral communications. To understand and appreciate the station bulletins the farmers must in many cases be taught something of the elements of agricultural science and must have their objections to the introduction of new methods of farming met and overcome by personal contact with the living teacher. This need has already been partially met by the farmers' institutes.

These institutes had their origin in farmers' societies of various kinds, some of which date back half a century or more, but State aid to such meetings is mostly confined to the last thirty years. The participation of the State in giving itinerant instruction to farmers is largely the result of efforts put forth by members of agricultural college faculties in different parts of the country. In Iowa this work was begun as early as 1869; in Vermont, Michigan, and some other States, a few years later. In nearly every case these early institutes were supported by funds diverted from the regular college funds. That there was a demand for farmers' institutes is shown by the increasing appropriations for their support. In 1891 nearly \$80,000 was spent for farmers' institutes in the United States, but of this sum not more than \$60,000 was specifically appropriated for this purpose. In 1899 the specific appropriations for institute work aggregated \$140,446.72, more than twice the sum thus appropriated in 1891, and the estimated expenditure of funds derived from other sources was \$30,000, making a grand total of more than \$170,000 expended for 2,000 farmers' institutes, which were attended by over half a million farmers.

Farmers' institutes are now held in 43 States and Territories. In 19 of these the institutes are under officials of agricultural colleges or experiment stations, in 17 they are under State or county officials, and in 7 they are under the joint control of State officials and college or station officials. Successfully conducted institutes are found under each system of management. In Wisconsin, for example, institutes are held under the auspices of the board of regents of the State University. About 120 institutes are held each year and the aggregate attendance is about 55,000. Each institute extends over two days, except the last, which is a three-day round-up institute. For the support of these institutes the State legislature appropriates \$12,000 a year. Agricultural college officials do a limited amount of work at a few of the meetings. In Michigan the legislature has placed farmers'

institutes under the control of the State board of agriculture, which has charge of the agricultural college. The director of the experiment station is superintendent of institutes. The meetings are held under the auspices of county institute societies, the officials of which indicate their choice of State speakers from a list sent them by the superintendent, and then, after the superintendent's assignments are made, arrange for local speakers and provide accommodations. There are held annually about 70 two-day county institutes, 100 one-day meetings, and the three-day State round-up institute. The total attendance at all sessions is upward of 100,000 annually. For the last biennial period, 1898-1900, the legislature appropriated \$11,000 for institutes, but hereafter the State board of agriculture will set aside whatever is needed for this work from an appropriation of \$100,000 placed under their control for the support of the agricultural college, the experiment stations, and college extension work. Several members of the college and station staff devote a portion of their time to institute work.

New York and Pennsylvania have State control of farmers' institutes. In the former State the work is under the auspices of the commissioner of agriculture, who appoints a director of institutes. About 300 meetings are held each year, and the total attendance is 75,000, or more, annually. The appropriation for 1898-99 was \$20,000 per annum. In Pennsylvania the institutes are held under the direction of the deputy secretary of agriculture, who is director of institutes. The meetings are distributed according to the number of farms in each county—two-day institutes to every county having not over 1,000 farms, three-day institutes to each county having more than 1,000 but not over 1,500, afterwards one day for each 1,500 farms or fraction thereof additional. About 300 institutes are held each year, and the total attendance is over 50,000. The annual appropriation for institutes is \$12,500. Three or four members of the college staff and two members of the board of trustees give their whole time to institutes for a period of about three months.

In some European countries itinerant instruction for farmers is very thoroughly organized. In Belgium the department of agriculture sends out lecturers who give 15 lectures between October and March in each of about 230 communes, provided there is an attendance of not less than 15. The state pays the expenses of these lectures and grants reduced railway fares to persons traveling to attend; the commune supplies the room for the lectures and advertises the date and place for them. Prizes of books are given as an encouragement to attend. This system of lectures does not interfere with the system of occasional lectures given by State agriculturists and numerous specialists on different subjects connected with agriculture. In France there are over 100 departmental professors of agriculture who, besides giving courses in agriculture in public normal schools, where teachers for rural primary schools are trained, also hold at least 26 institutes each year. The lectures given are for the purpose of enlightening the cultivators regarding seeds and varieties, fertilizers, new implements, selection and feeding of animals, treatment of old and new vineyards, insect ravages, drainage, etc. In both countries the lecturers superintend numerous demonstration fields on private estates where ocular demonstrations of the advantages of modern methods in agriculture are given.

The farmers' institute movement in the United States is an important one, and is yearly becoming more important. Attendance at the

meetings is increasing and appropriations are becoming more liberal. Indiana's appropriation for the current year is double what it was last year; Montana has made its first appropriation for institutes, \$2,000; Tennessee, Maryland, and Missouri have increased their appropriations by \$1,000 to \$2,000 a year, and other States have made minor changes for the improvement of their institute systems.

The farmers' institute movement has now reached such a stage of its development as makes it apparent that the comparatively simple methods hitherto followed in the organization and maintenance of the institutes are not adequate for an enterprise of such magnitude as this has become. Many problems regarding better organization and further development of the institutes have arisen, the solution of which will require much study involving the comparison of methods employed in different States and countries. In its national and international aspects there is room for much useful work by this Department, which may well aid in this as in other movements for the education of our farmers and the improvement of our agriculture. As the farmers' institutes are already closely identified with our agricultural colleges and experiment stations, it seems to me that it would be entirely proper for this Office as the central agency for the promotion of the interests of these institutions to also undertake the active promotion of the interests of the farmers' institutes. In this way the Department might accomplish much useful work in aiding to extend the institutes to regions where they have not hitherto been held, to strengthen the movement where it is weak, and to secure more efficient organization where its value is already appreciated by the people. I have therefore recommended (see p. 177) that Congress be asked for an appropriation of \$5,000 to enable this Office to undertake this work. For this purpose there should be attached to this Office an officer who can devote his time to conferring with the institute managers in the different States, attending representative institutes in different parts of the country, studying the problems of institute organization at home and abroad, and giving advice and assistance wherever opportunity offers.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The fourteenth annual convention of this association was held at New Haven and Middletown, Conn., November 13-15, 1900. The Director of this Office was a delegate and was also reelected bibliographer of the association. The Office was further represented by the assistant director, Dr. E. W. Allen. The stenographic report of the proceedings was prepared under the supervision of the Director, and has since been edited by him and Mr. W. H. Beal, of this Office, and the chairman of the executive committee of the association, and issued as Bulletin No. 99.

The committee on the collective experiment station exhibit at the Pan-American Exposition made its final report, in which it was recommended that the exhibit be kept intact and installed as a permanent exhibit at some place in the city of Washington.

Reports were made by the committees on methods of teaching agriculture, indexing agricultural literature, and graduate study at Washington, D. C. The Director of this Office has performed a considerable amount of work during the past year as a member of the four committees above mentioned.

The committee on cooperative work between this Department and the stations made a report, which was adopted by the association. This report commended the attitude of the Secretary of Agriculture toward closer cooperation between the Department and the stations, and pointed out the different ways in which the two institutions might aid each other. It also outlined the principles on which, in the opinion of the committee, joint work could be arranged and conducted.

The twenty-fifth anniversary of the establishment of agricultural experiment stations as State institutions was celebrated at Middletown, Conn., where the first of these stations was established. On this occasion interesting and valuable papers were presented by Dr. W. H. Jordan, of New York, on American Agricultural Experiment Stations, and by Prof. W. O. Atwater on the History of the Connecticut Experiment Stations.

A carefully prepared and eloquent address on the career of the late Justin S. Morrill, of Vermont, was delivered by Dr. G. W. Atherton, of Pennsylvania. Dr. Bernard Dyer, of London, England, attended the convention as the representative of the Lawes Agricultural Trust, and delivered a course of three lectures based principally on the investigations at the Rothamsted Experiment Station of soils which have been in continuous wheat culture. It is expected that these lectures will be published later through this Office. Besides resolutions of thanks to Dr. Dyer, the association adopted a memorial expressing its high appreciation of the life and work of the late Sir John Bennet Lawes and his associates at the Rothamsted station.

RELATIONS WITH FOREIGN INSTITUTIONS.

During the year the relations of this Office with foreign institutions for agricultural education and research have become more intimate through correspondence and exchange of publications, and much reliable information regarding these institutions has been made available. A card catalogue of foreign agricultural colleges, secondary schools of agriculture, and experiment stations, giving references to the available literature on these institutions, has been prepared, the list of foreign experiment stations has been revised and published, and the work of writing, for publication in bulletin form, an account of the organization, equipment, expenditures, and work of the 700 stations in this list has been nearly completed. Closely related to this work was an article on Agricultural Education in France, written for the Yearbook of the Department, by Mr. C. B. Smith, of this Office.

Instances of governmental activity for the advancement of agriculture are numerous, both in the Old World and in the New. In Russia the ministry of agriculture has inaugurated a system of commissioners of agriculture—one for each of twenty provinces or governments—who will correspond in a general way to our commissioners of agriculture or to secretaries of State boards of agriculture. With each commissioner's office will be connected a corps of agricultural specialists, who will work among the landowners and peasants.

In England the agricultural-education committee is doing an important work for agriculture and agricultural education by publishing circulars on various topics and teachers' leaflets on "Nature knowledge" (nature study), and the number of private institutions for research has been augmented by the establishment of the Aynsome Experiment Station at Lancashire by Mr. John S. Remington.

The Austrian Government has recently established several experi-

ment stations, notably the station for plant culture at Brünn, a station for investigations in plant and animal production at Otterbach, and an agricultural physiological station with divisions of chemistry, physiology, and bacteriology at Prague. In Hungary an experiment station for wines was established last year at Fiume.

France has established an œnological station at Toulouse and a colonial garden at Nogent-sur-Marne. The latter will have administrative control over French colonial stations and botanic gardens, and will furnish these institutions with seeds and plants.

In Germany five years of successful work at the Lauchstadt Experimental Farm, which is connected with the experiment station at Halle, under the direction of Dr. Max Maereker, have given so much evidence of the value of experimental farms in connection with experiment stations that there is a movement in that country toward the extension of the so-called "American system" of field experiments conducted on a large scale and in a more practical way than has hitherto been customary at experiment stations there.

A department of agriculture, with a small staff of experts, has been organized at Bangalore by the government of Mysore, India.

In the West Indies and South America, also, the claims of agricultural education and research have received a large share of attention. Meetings in Barbados have shown great interest in agricultural education, and in the course of the year three new experiment stations have been established at Montserrat and one at Tortola. The Bolivian Government has established an agricultural college at Cochabamba and an agricultural school for Indians at Umala. Brazil has recently established a botanical garden and experimental demonstration field at San Vicente, and the Argentine Republic has decided to establish four experiment stations on the same general plan as those in the United States.

PUBLICATIONS OF THE OFFICE.

During the year the Office issued 52 documents, aggregating 3,843 pages. These include 14 numbers of the Experiment Station Record, with detailed index, 18 bulletins, 5 farmers' bulletins, 1 report, 2 Congressional documents, 3 circulars, 3 articles for the Yearbook of the Department, and 6 special articles published as separates.

EXPERIMENT STATION RECORD.

General editorial management of the Record has been intrusted to the assistant director, Dr. E. W. Allen, during the past year, as heretofore, and he has also continued to act as chairman of the abstract committee of the Association of Official Agricultural Chemists. Volume 12 of the Record was completed, and the preliminary work on the combined index to the first 12 volumes was accomplished. Even with the condensation which has been adopted in this combined index, it includes upward of 100,000 separate entries. The combining of these so as to bring the related references together under suitable general entries, in order to make it a practical working index, remains to be done. It is hoped that the index may be made ready for the printer during the coming year.

The Experiment Station Record has a value for two purposes, (1) as a record of current investigation on agricultural science, and (2) as an annotated bibliography of recent work. Its value, with its

detailed index, as a means of looking up work which has been done on a particular subject, increases with each volume issued. The combined index, which is in preparation, will furnish a full subject index to experiment station work since the passage of the Hatch Act, and to a very large proportion of the contemporaneous investigation along lines related to agriculture.

The demand for the Record has necessitated a small increase in the edition during the year. Its circulation is, as before, confined to such persons as are engaged in agricultural research or instruction, under a fairly broad interpretation. The foreign list is sent largely in exchange at present and results in an increasing amount of periodical literature, experiment station reports, separates, and scientific papers which materially assist in following up the foreign literature of agricultural science.

The review of the literature of agricultural science in the Record is made more complete and comprehensive year by year, and the development of various agencies for agricultural investigation adds constantly to the material to be reviewed. During the past year no less than 1,500 scientific journals, periodicals, and serials have been followed up systematically, some of these being weeklies. In addition to these a very large number of reports of municipal, State, and Government experts, commissions, and boards from all over the world have been reviewed. That the great amount of labor involved in the issuing of the Record is not misdirected is evidenced by the place which it has taken among abstract journals and by the use which is being made of it by the nearly two thousand experiment station investigators, agricultural instructors, and public officials who receive it. Fewer leading articles were included in the last volume than in some of the previous volumes owing to a lack of available space. Several valuable articles have been secured whose publication it was necessary to postpone. This pressure of material has made it necessary to print the Record in a smaller type in order to gain space. Beginning with Volume XIII brevier type has been used in place of long primer, which will enable about one-third more material to be printed without increasing the number of pages.

The twelfth volume of the Experiment Station Record comprises 1,205 pages, and contains abstracts of 348 bulletins and 55 annual reports of experiment stations in the United States and 158 publications of the Department of Agriculture. The total number of pages in these publications is 31,268. The total number of articles abstracted is 3,271, classified as follows: Chemistry, 172; botany, 158; fermentation and bacteriology, 38; zoology, 31; meteorology, 99; air, water, and soils, 135; fertilizers, 139; field crops, 353; horticulture, 320; forestry, 130; seeds and weeds, 80; diseases of plants, 248; entomology, 334; foods and animal production, 314; dairy farming and dairying, 181; veterinary science, 347; technology, 25; agricultural engineering, 56; statistics and miscellaneous, 121.

Special articles were also published in this volume of the Record as follows: "Notes on horse feeding," by E. Lavalard; "New agricultural building at Kansas State Agricultural College;" "International congresses of horticulture, viticulture, and agriculture at Paris," by W. H. Evans; "New building for the College of Agriculture at the University of Illinois," and "Russian soil investigations."

There are condensed accounts of the Proceedings of the Fourteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, by E. W. Allen, of this Office, and

of the Seventeenth Annual Convention of the Association of Official Agricultural Chemists, 1900, by D. W. May, of this Office; and in addition, editorial discussions of the following topics: The promotion of agriculture in Russia, agricultural experiment stations for Hawaii and Porto Rico, international congresses of agricultural experiment stations and of agricultural education at Paris, the late Sir John Bennet Lawes, the influence of the Rothamsted Experiment Station, experiment station exhibits at the Paris Exposition, need of more perfect organization of the experiment stations, differentiation of the investigator from the teacher, some recent bibliographic helps, protection of crops from hail, the scope and management of the veterinary work of the experiment stations, investigation of soils in Russia, variety testing at Woburn Experimental Fruit Farm, cheese curing in the light of the enzym theory, the agricultural appropriation act, experiment-station farms and the movement for their establishment in Germany, the Hawaii experiment station, and Maxime Cornu, botanist, horticulturist, and agriculturist.

MISCELLANEOUS PUBLICATIONS.

The miscellaneous publications of the Office consists chiefly of (1) technical bulletins and reports, and (2) Farmers' Bulletins, including the series known as Experiment Station Work, and are prepared under the immediate editorial supervision of Mr. W. H. Beal.

TECHNICAL BULLETINS.

Organization Lists of the Agricultural Colleges and Experiment Stations in the United States, with a List of Agricultural Experiment Stations in Foreign Countries (Bulletin No. 88, pp. 181), contains a list of the officers of the Association of Agricultural Colleges and Experiment Stations and of the Association of Official Agricultural Chemists; a list of institutions having courses in agriculture in the United States, with courses of study and boards of instruction; a list of experiment stations in the United States, with governing boards and station staffs; a list of experiment stations in sixty-seven foreign countries, with their location and directors; a list of station publications received by the Office of Experiment Stations during 1900; Federal legislation affecting agricultural colleges and experiment stations, and regulations and rulings of the Federal departments affecting the stations. The bulletin contains a complete index of names.

A Report on the Work and Expenditures of the Agricultural Experiment Stations for the year ended June 30, 1900 (Bulletin No. 93, pp. 181, pls. 8). This contains the report of the Director, which is referred to elsewhere (p. 181).

Fourth Report on the Agricultural Investigations in Alaska, 1900, by C. C. Georgeson, special agent in charge of Alaska investigations (Bulletin No. 94, pp. 83, pls. 24). The investigations reported in this bulletin are referred to elsewhere (p. 202).

Report on the Agricultural Resources and Capabilities of Hawaii, by William C. Stubbs, director of the Louisiana Agricultural Experiment Stations (Bulletin No. 95, pp. 100, pls. 28). The subject-matter of this report is discussed on page 207.

Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the year ended June 30, 1900 (Bulletin No. 97, pp. 37), shows the number of officers and students, endowment, equipment, and revenue of the colleges, and the number of officers,

revenues, expenditures, lines of work, additions to equipment during the year, and number of publications of the stations.

Agricultural Resources and Capabilities of Porto Rico, by S. A. Knapp (House Doc. No. 171, Fifty-sixth Congress, second session, pp. 32, pls. 7). A report on investigations of the agricultural resources and capabilities of Porto Rico, with special reference to the establishment of an agricultural experiment station in that island. The report discusses the climate, soils, and industrial conditions of the island; the agricultural and horticultural products, especial attention being given to the sugar, coffee, and tobacco industries; the character of labor and farm wages; the agricultural depression and the possibilities of agriculture in the island, and makes recommendations regarding agricultural investigations.

Proceedings of the Fourteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at New Haven and Middletown, Conn., November 13-15, 1900 (Bulletin No. 99, pp. 192, pls. 3), contains, in addition to the proceedings of the convention, papers, addresses, and reports on a number of subjects of interest to students and investigators in agricultural science. The proceedings were edited for publication by the Director and Mr. W. H. Beal, of this Office, and the chairman of the executive committee of the association. A limited number of separates of the principal papers contained in the bulletin have been printed.

Agricultural Education in France, by C. B. Smith (Yearbook of the Department of Agriculture, 1900, pp. 115-130), describes the system of agricultural education in that country.

A brief statement regarding other bulletins issued in connection with the investigations in nutrition and irrigation may be found on pages 221, 229, respectively.

FARMERS' BULLETINS.

Beans, Peas, and Other Legumes as Food, by Mary Hinman Abel (Farmers' Bulletin No. 121, pp. 32, figs. 10). Beans, peas, lentils, and other legumes, used fresh or dried, as articles of diet, are described, and their food value as compared with other vegetables and with animal foods is discussed. The principles which govern the cooking of leguminous vegetables are treated, and statistics are given of the use of such foods and their importance in the diet.

Eggs and Their Uses as Food, by C. F. Langworthy (Farmers' Bulletin No. 128, pp. 32), describes different kinds of eggs used for food, and summarizes the available information regarding their composition and uses and value as articles of diet.

There was also submitted for publication during the year Irrigation in Field and Garden, by E. J. Wickson (Farmers' Bulletin No. 138, pp. 40, figs. 18), which gives practical directions for the construction of small ditches, the collection, storage, measurement, distribution, and application of water for the use of the individual farmer.

EXPERIMENT STATION WORK.

Two numbers (Nos. XVI, XVII, Farmers' Bulletins Nos. 122, 124) of Experiment Station Work, the subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries, were issued during the year, and a third number (XVIII, Farmers' Bul-

letin No. 133) was submitted for publication. In the preparation of these bulletins the effort has been made to take into account the work done at the different experiment stations and to compare results obtained under different conditions, so as to present a more complete view of the progress of investigation in special lines than could be given by abstracts of the reports of single investigations. While it has been our effort to show the practical application of these results, we have also tried to so present them as to make clear to the reader that our articles are intended to be essentially reports of progress in agricultural investigations rather than final and authoritative recommendations of changes in farm practice. It is believed that one of the most important things which our farmers have to learn is that they are not to follow blindly the advice of experts whose investigations have necessarily covered only certain features of the complex problems of practical agriculture. The farmer should be made acquainted in a broad way with the results of investigations carried on by the experiment stations and kindred institutions, and taught how to take advantage of the results of these investigations through his own knowledge and skill as applied to the conditions existing on his own farm. The popularity of these bulletins is evidenced by the large and increasing demand for them, necessitating frequent reprints.

CARD INDEX.

Copy for 1,900 cards of the index of experiment-station literature has been prepared in the Office and forwarded to the Division of Publications during the year. Preparation of the index is now kept as nearly up to date as the irregularity of publication of station documents will permit. The number of index cards distributed has reached 21,500. The receipts from sales of this index during the year were \$163.76.

BIBLIOGRAPHICAL WORK.

The Office has cooperated with the Library of the Department in the preparation of a list of works on irrigation, land drainage, and closely allied subjects, which is now ready for the printer. A list of Russian dissertations on veterinary subjects has been completed during the year by a member of the Office force, and bibliographies of the botany of maize and nitrogen assimilation, and the sources of data relating to analyses of American farm products have been added to. Considerable additions have also been made to the bibliography of nutrition of man and animals, especially of bread and closely allied topics.

The collection and cataloguing of publications of the agricultural colleges and experiment stations in this and other countries have been continued during the past year as heretofore. A large number of foreign publications of all kinds has been received as exchanges. Many duplicates of station and other publications were received, a considerable number of which were distributed to college and station libraries and officers. The number of requests from college and station officers for the loan of books from the Department Library has greatly increased. The service thus rendered by the Department is greatly appreciated by these officers, many of whom do not have access to large libraries, and it is hoped that hereafter such privileges may be further extended.

WORK FOR THE CIVIL SERVICE COMMISSION.

The Director of this Office has continued to act as the general representative of the Department in matters relating to examinations held by the Civil Service Commission for technical and scientific positions in the Department. The number of papers received from the Commission, recorded in this Office, and rated by examiners in the Department during the year was 260. Besides the regular examinations 22 special examinations were held during the year. The register for "scientific aids," confined to graduates of the land-grant colleges, continues to be a useful one, and an increased number of appointments has been made from it during the past year. In some branches of the service the number of eligibles on this list has not kept pace with the demand. The "scientific aid" register has, however, to a considerable extent taken the place of the register for "assistants," and for that reason the regular examinations to fill the latter register have been discontinued. A plan for combining the "scientific aid" and "assistant" registers with a view to providing a system for the entrance of competent "scientific aids" into the classified service has been approved by the Commission. The partial reorganization of the Department due to the establishment of new bureaus has caused a temporary increase in the number of special examinations.

EXPERIMENT STATIONS IN ALASKA.

The fourth appropriation for agricultural investigations in Alaska was made for the fiscal year beginning July 1, 1900, but a portion of this appropriation was made available in the spring of that year. The appropriation was \$12,000, and its terms were the same as those in the previous year, authorizing the Secretary of Agriculture to expend this fund "to investigate and report to Congress upon the agricultural resources and capabilities of Alaska, and to establish and maintain agricultural experiment stations in said Territory, including the erection of buildings and all other expenses essential to the maintenance of such stations."

Prof. C. C. Georgeson has been continued as special agent in charge of these investigations, with assistants at Sitka and Kenai, in the coast region, and Rampart, in the interior. The chief new feature of the investigations during the past year has been the more thorough study of the agricultural possibilities of the interior, especially the Yukon Valley. For this purpose Professor Georgeson made a journey through the interior between June 19 and September 18, 1900. A detailed account of this investigation was given in Professor Georgeson's report for 1900 (Bulletin No. 94 of the Office of Experiment Stations), of which he has made the following summary:

I was accompanied by one assistant, Mr. Isaac Jones, who was to remain in the interior and take charge of the work we might undertake there. We went in via Skagway, over the railroad to White Horse, and by boat down the Yukon to Dawson, at which place we arrived July 3. We found no boats at Dawson going down the river, none having come up from St. Michael at that time. I therefore bought a scow, in which we packed our outfit, and I hired a man to help us navigate it and sent it adrift down the river on the evening of July 5. We stopped at Eagle, the first town in American territory, and at Circle City. At the latter place we were compelled to abandon the scow and take a boat, for the reason that we doubted our ability to work it through the stretch of 300 or more miles across the Yukon Flats. We found small gardens both at Eagle and Circle, and at the former especially these gardens were numerous and promising. We found that potatoes and nearly the entire list of hardy vegetables were doing nicely.

At Circle we took a boat for Fort Yukon. There being vast stretches of level land in this region, I made a reservation of 106 acres for an experiment station. This occupied us some days, and while waiting for a boat we broke up a small piece of sod with a view to having it in readiness for seeding this year, should we find it practicable to begin experimental work there.

Continuing down the river, we examined the conditions wherever the boat stopped. At Rampart the conditions seemed favorable for an agricultural experiment station. A tract of land on the north side of the river, directly opposite the town of Rampart, seemed well adapted to the purpose. It was more or less densely covered with spruce forest, but some clearings had been made by wood choppers, and it was thought that by judicious handling of fire a portion of the tract could be cleared and put under culture without incurring too great expense. I therefore made a reservation at this place, having a mile frontage on the river and running back half a mile. Some cabins which had been built by Indians and others near the river bank were cut out by offsets, so the reservation proper comprises about 313 acres. When this work was completed we again dropped down the river as far as Weare, some 80 miles below Rampart. At this point we had an opportunity to examine the Tanana country by taking advantage of the opportunity afforded to go up the river in a little Government boat belonging to Fort Gibbon. There appeared to be much available farming land in this region, but, as was the case on the Yukon, the best land was rather heavily timbered, chiefly with spruce and also with birch and balsam poplar. We ascended the Tanana for about 100 miles, but I made no reservation in this region.

On returning to Weare, Mr. Jones went up to Rampart and began work on the reservation made there. I continued down the river to St. Michael, stopping at the usual landing places.

The most successful gardening which came to my notice on the trip was at Holy Cross Mission, some 350 miles from the mouth of the Yukon. At this mission there is about 4 acres under culture, and the missionaries are very successful in growing potatoes, cabbage, cauliflower, turnips, carrots, parsnips, lettuce, radishes, and, in fact, the entire list of hardy vegetables. I was there on the 7th of August, but little over two months after the gardens were planted, and they had fine cabbage and vegetables of many kinds.

The superintendent of the mission, Father R. J. Crimont, agreed to undertake some experiments in grain growing during the present year. Seed grain was accordingly furnished him and the general plan of experiment agreed upon. I also provided him with a set of soil thermometers, and he promised to keep a record of the soil temperature at that place during the present season.

At St. Michael General Randall, commanding the Department of Alaska, kindly provided me with transportation on the transport *Lawton* to Seattle. The *Lawton* was at Nome discharging freight, and I had to go over there to catch her.

At Dutch Harbor and Unalaska I saw fine gardens and an abundance of cultivated flowers, and quite a number of cattle, sheep, hogs, and poultry, indicating that stock raising and gardening could be carried on in that region with marked success. There is an abundance of pasture on the Alaska Peninsula and adjoining islands, grass having taken the place of spruce forest so universal in southeast Alaska.

During the present summer Professor Georgeson has gone again into the interior, and under date of August 15, 1901, reports that while at the Holy Cross Mission, on the Yukon River, during the second week in August, the mission was supplied from its own garden with new potatoes, cauliflower, cabbage, and other vegetables, and that on the station reservation at Rampart "rye seeded last fall wintered perfectly, and it was ripe early this month. Barley, spring seeded of course, is now ripe enough to grow. Oats and spring wheat are somewhat later, but they are filling out and may ripen. Mr. Jones also planted a long list of vegetables, but they have been nearly totally destroyed by rabbits, and what is left of the lot have not grown well in the new soil, again confirming our oft-repeated experience that it requires some two or three years to get new soil in proper tilth for vegetables. Mr. Jones has agreed to go out over the trail from Eagle to Valdez, and we shall thus have an authentic description of that interior country."

Mr. Jones is unwilling to remain longer in the Department service;

but an arrangement has been made with Mr. J. W. Duncan, a resident of Rampart, to care for the station property there and do some fall and spring seeding.

At Sitka the experiments with cereals, forage crops, and vegetables were continued during the season of 1900, and a considerable number of varieties were successfully grown. An extensive series of experiments was conducted with fertilizers, illustrating their effect on new soil, as shown in the production of oats, barley, and potatoes. During the present season similar experiments have been continued, and an attempt has been made at growing forage crops for the maintenance of the station cattle. The experimental cropping the present season has been confined to those varieties which have been successful heretofore, the object being to secure Alaska-grown seed for the use of the station and for distribution in small quantities among residents. Some fertilizer experiments with seaweed, stable manure, and fish guano are under way.

A successful experiment was made in the construction of a log silo and the preparation of silage. Regarding this, Professor Georgeson writes as follows:

A log silo was built during July and August, 1900, by my assistant, Mr. Rader. A silo was needed, and it was built of logs as an experiment, in order to ascertain if settlers could build a satisfactory silo by this means. It is 15 by 15 feet square inside and 13 feet high. The logs are fitted together and chinked with moss in such a manner as to make the walls perfectly air-tight. The logs were dressed on the inside so as to present a smooth wall. It was roofed with boards, and a temporary cattle shed for the cattle was built against one side. The silo is built in the side of a hill, with a driveway over the hill at the back, so that the material can be pitched over the top log of the silo without much exertion. It was filled with native grasses during the latter part of September. The experiment was an entire success. Our work oxen were fed exclusively on silage from November 10 to May 1, and only when they were worked were they fed grain in addition. They ate the silage with relish throughout and were maintained in good condition. There was no greater loss of silage by waste than always occurs in preserving green forage.

During the past year some advance has been made toward building the station headquarters at Sitka, but unfortunately the appropriation for the current year will not permit the completion of this building. Only the first story is in a condition to be used at present, and the exterior of the building is still unfinished. The necessary plumbing was done in this building during the past winter by Professor Georgeson and his assistant, when it was found through bids that this work could not be otherwise done except at excessive cost. A rain-water tank holding 4,700 gallons was constructed near the building in a similar way. It is estimated that by doing the work in this manner some \$500 was saved.

During March of the present year the station force "cut a raft of wood in a bay some miles from town and towed it in with the launch. It will supply most of the fuel needed during the present year."

During the present summer the station force at Sitka has also built a barn and four-room cottage on the station farm. The barn joins the silo and is 25 by 50 feet and two stories high. The lower story will have a tool room, furnish storage for farm implements, and have stalls for half a dozen head of cattle. The upper story is provided with a tight floor and will be used chiefly for the handling of grain and seed. The cottage is 16 by 30 feet and a story and a half high. There are at present only two rooms on each floor, but it is contemplated to build a kitchen as an addition to one side later on. This cottage is needed to provide quarters for the man who has charge of the cattle and who

can look after the numerous things which require constant attention at the farm.

Considerable work has also been done on a drainage system for the station farm. The launch *Ware*, transferred from the Navy Department to this Department and assigned to the Sitka station, needed considerable repairing before it could be made serviceable. These repairs were made by Mr. Rader. The little boat was then made fairly seaworthy, and has since been of much use to the station in procuring grass, wood, etc., as well as for transportation.

At Kenai experiments with cereals and vegetables have been continued with considerable success. A number of varieties matured during the season of 1900. Some fall-seeded rye and wheat survived the past winter in fair condition. The greater portion of the grain seeded last spring at this station is from grain grown there last year and the year previous, which indicates that grain can be matured and propagated in that latitude. Between 5 and 6 acres have been cleared and fenced and are in culture. About 3 acres of this were cleared last year and are cropped this year for the first time.

During the past year the assistant in charge of the station has built a five-room log house for the use of the station. All the work at Kenai has been done by Mr. H. P. Nielsen, the assistant in charge, and one laborer. Mr. Nielsen deserves great credit for the energy and faithfulness which he has shown in doing a large amount of hard and rough work under difficult circumstances.

Professor Georgeson visited the Kenai station in June of the present year, and writes as follows regarding the climatic conditions there:

A new difficulty has arisen in connection with our experiments at Kenai, and that is a drought during the spring. This has been the case during the past two years. There was moisture enough in the soil to start the seed growing, but on account of dry weather the growth has been slow up to the present time (July 17). During the month of June the rainfall amounted to only .06 of an inch. I do not know whether the past two years represent the average of the seasons in the Kenai Peninsula in that respect. If they do, this feature will be a greater obstacle to successful farming than cold weather.

Besides the experimental work at Sitka and Kenai, seeds have been distributed to over 400 persons living in different parts of Alaska, and a considerable number of reports have been received from those grown there during the season of 1900. There is a considerable increase in the demand for seeds now that it is known that they are being distributed through the station. Not only are vegetables, cereals, and forage plants asked for, but there is a considerable demand for flower seeds. There seems to be a great desire on the part of a certain class of explorers in Alaska to cultivate flowers, which are more than ordinarily prized in a region where the general conditions of life are so comparatively hard.

Professor Georgeson has continued to supervise all the voluntary observers of the Weather Bureau of this Department in the coast region of Alaska. These observers send their monthly reports to the station at Sitka, where one copy is kept on file, while another is sent to the chief of the Weather Bureau at Washington.

In connection with the annual visitation of the experiment stations in the different States and Territories, Dr. E. W. Allen, the assistant director of this Office, went to Alaska during the present season and has made the following report of his observations there:

In connection with a tour of the experiment stations in the Northwest, I proceeded to Alaska during the month of July for the purpose of examining the condition and work of our agricultural experiment stations there. My visit was con-

fined to the coast regions, as time would not permit a trip into the interior. Stops were made at Wrangell, Juneau, and Skagway on the way up to Sitka, and after a brief stay at the latter place I made a trip to the westward as far as Cook Inlet and Kadiak, returning thence to Seattle. The trip to the westward gave opportunity for inspecting the work of our station at Kenai, for looking over the reservation at Kadiak, and for observing what is being done in the line of gardening at various points along the route.

The impression which I gained from this Alaskan trip was that not only is a quite wide range of gardening and some measure of agriculture possible, as has been shown by the Congressional reports of our experiments there, but that a gratifying amount of educational and demonstration work has been done among the people, which is already productive of good results. A number of private residences about Sitka show what can be accomplished by well-directed industry in beautifying them and in maintaining creditable home gardens. Many of the natives plant gardens of vegetables and flowers, and a considerable number give them fairly good care. Near the town men were engaged in making hay on a small tract, and, with the weather prevailing at the time of my visit, it was quite practicable to dry the hay in the field. Numerous gardens containing lettuce, radishes, cabbage, peas, potatoes, and the more hardy vegetables generally were to be seen at the various places where I landed along the way. These gardens were for the most part well cared for and usually an object of pride. The quality of the vegetables raised was said to be excellent, and failures were few with persons who understood the best methods. At Kenai the gardens of the natives presented an especially well-cared-for and thrifty appearance. In many places the natives have come to appreciate the value of vegetable food in improving their diet, and the variety which a garden of fresh vegetables lends to the food of the newer residents of Alaska is much appreciated by them. Flower beds of sweet peas, pansies, and a number of other kinds of plants were not uncommon.

The seed for planting these gardens and the directions and encouragement for maintaining them have come very largely from the special agent in charge of the Alaska station and his superintendents. Everywhere I went along the coast region I found that the work of the Alaska stations was well known and usually very favorably regarded at present, although many admitted that they had at first viewed the undertaking with much skepticism. Hardly a man was addressed who did not know about Professor Georgeson and his work. This is the more remarkable and stronger evidence of the interest which has been aroused when it is considered that there are practically no newspapers in Alaska having more than a local circulation, that no publications except Congressional reports have been issued, and that, owing to the difficulties of transportation, people do not get about as much as they do in the States. The extent to which information has been diffused and the confidence of the people won speak much for the vigor and industry with which the work has been prosecuted. The propaganda has met with a good measure of success, and the work now has many strong friends, particularly in the western coast region, where the conditions are the most suitable for agriculture.

I was impressed with the many difficulties which our agent has had to meet in carrying on his work under such pioneer conditions, at a number of points widely separated. Transportation is entirely by water and is slow; mails are infrequent; the need for material of various kinds must be anticipated several months; labor of the right kind for our work is very difficult to procure; the work must be accomplished in a short summer season, and a thousand and one little annoyances arise to hinder and discourage the undertaking. It is only through untiring energy and enthusiasm for the work and the exercise of the strictest economy that Professor Georgeson has been able to make the good showing that he has for the time and money he has had at his disposal. I do not hesitate to say that, despite these difficulties and the higher prices to be met, few, if any, of our experiment stations in the early years of their existence have been able to make a better showing for the money expended in the way of buildings, permanent improvements to the land, and amount of experimental work performed than the Alaska stations do to-day, and the interest and confidence which have been aroused by the stations are worthy of any station in the newer States.

Now that such favorable results have been obtained with vegetable growing and some of the cereals, I am of opinion that work might be undertaken with animals to show the extent to which feed for them can be profitably or economically grown in Alaska. Fresh meat is scarce and dear; it is only occasionally that fresh meat can be obtained to the west of Sitka. With small animals, like poultry, useful work might be done in showing what feeds can be grown for them and how they can best be cared for. Poultry raising would be the simplest beginning in animal production and might lay the foundation for work with larger animals. The hog is not commonly found, but summer pasturage for hogs could surely be

raised, and it seems very probable that winter feed could be grown also. The profitableness of hog raising in a small way and the quality of the pork which could be produced without corn would be a good subject for investigation. Cattle raising and milk production have been tried as a business venture on a small scale at a few places. In most instances, however, the feed for the animals has been very largely shipped in, and it remains to be demonstrated to the satisfaction of the people at large, at least, that the necessary grain and feed can be profitably raised, so that products of good quality can be made without relying upon feeds imported from Puget Sound.

From the experience already had, I am inclined to regard the raising of cattle for beef and for milk production in Alaska as entirely feasible. There are good pastures in places, and natural meadows where hay of good quality can be made. From a commercial point of view the present freight rate on live cattle from Seattle to the Cook Inlet region would give the local cattle raiser the advantage of a protective tariff. Kenai or Kodiak seem well adapted to experiments of this nature, and are representative of quite large areas of country. I would recommend that the building up of a herd of cattle with reference to conducting experiments in the feasibility and profitableness of beef and milk production, using home-grown products to the largest possible extent, be taken up as soon as circumstances and the funds at disposal for this work will permit. In the meantime the distribution of seeds of varieties of plants found especially adapted to Alaskan conditions should be continued, with the possible dissemination of information, in the form of popular circulars or bulletins, regarding the progress of the work and directions for preparing and caring for gardens.

With the present appropriation it will be impracticable to do more than continue the investigations in Alaska on the lines on which they are now being conducted. Additional funds are required for the completion of the headquarters building at Sitka, for the erection of small buildings at Rampart and the equipment of the station there, for the employment of an expert horticulturist, whose services are greatly needed, and for the purchase of live stock. The annual appropriation for the regular expenses of the Alaskan work should be at least as much as that for the experiment stations in the other Territories, namely, \$15,000. In addition to this, I would recommend an appropriation of \$5,000 to be used for buildings and the purchase and transportation of live stock.

EXPERIMENT STATION IN HAWAII.

The first appropriation for the establishment and maintenance of the agricultural experiment station in Hawaii was made for the fiscal year covered by this report. The appropriation was \$10,000 and provided for the erection of buildings and all other expenses essential to the maintenance of an agricultural experiment station, including printing (in Hawaii), illustration, and distribution of reports and bulletins. With a view to determining the conditions existing in Hawaii with reference to experimental investigations as related to the needs of the agriculture of that Territory, and the location of an experiment station, Dr. W. C. Stubbs, director of the Louisiana Agricultural Experiment Stations, was sent to Hawaii, as stated in my previous report, where he made a careful investigation with special reference to the organization and work of an experiment station. His detailed report was transmitted to Congress in January, 1901, and published as House Document No. 368 (Fifty-sixth Congress, second session), and afterwards as Bulletin No. 95 of the Office of Experiment Stations. Besides much valuable information regarding the agriculture of Hawaii, this report contains definite recommendations regarding the location, equipment, organization, and lines of work of the proposed experiment station in that Territory. It was recommended that the station be established under the direct control of

the Secretary of Agriculture and independent of existing local institutions. As the station already maintained by the Hawaiian Sugar Planters' Association will continue its work on problems relating to the sugar industry, it was recommended that the station to be established by this Department give its attention to other agricultural interests. It was pointed out that among the subjects to which the station should give special attention were the culture of fruit, vegetables, rice, forage crops, stock raising, dairying, coffee growing, irrigation, and forestry.

As the headquarters for the station, it was recommended that the reservation which the Hawaiian government had surveyed and mapped in 1893 for an experimental and forestry station be secured. This is a tract of 222 acres near Honolulu, known as Kewalo-uka, with an elevation ranging from 50 to 1,000 feet, and containing cleared and forest land.

On the basis of this report, a second appropriation of \$12,000 was made for the maintenance of an experiment station in Hawaii during the current fiscal year. Immediately on the passage of this appropriation act, which showed the determination of Congress to put the project of an experiment station in Hawaii on a permanent basis, Mr. Jared G. Smith, chief of the Section of Seed and Plant Introduction of this Department, was transferred to this Office and appointed special agent in charge of the Hawaii Experiment Station. He left Washington near the end of March and proceeded without delay to Honolulu, with instructions to establish headquarters there and to begin the organization of regular experiment station work in Hawaii. As a site for the station, he was to secure possession of the tract of land in Honolulu known as Kewalo-uka, and on this to begin the clearing and fencing of land and the erection of buildings. In making plans for experimental work, he was instructed "to consider especially the needs of the people of the Hawaiian Islands as regards the production of food supplies for home consumption, and the development of animal industry, dairying, and coffee culture, and to extend aid to the people of the different localities throughout the islands for the improvement and development of local agricultural industries through the distribution of seeds, plants, and publications, the giving of advice by correspondence and otherwise, and the institution of cooperative experiments." He was urged to enlist the cordial support and sympathy of the Hawaiian government and people in this enterprise, and he was to announce that it would be the policy of the Department "to encourage the granting of financial assistance to the station by the Hawaiian government, as in the case of the other States and Territories, where the National funds have been largely supplemented by local grants of money for buildings, equipment, and current expenses of the station."

On examination of the records of the Hawaiian government before the annexation of this Territory to the United States, it was found that while there were evidences of the intention of that government to reserve the Kewalo-uka tract for experimental purposes, the reservation had never actually been completed. Soon after the annexation of the Territory, on recommendation of the Secretary of the Navy, the President issued a proclamation (November 10, 1899) reserving 20 acres, more or less, of the best agricultural land on this tract as a site for a naval hospital, and on recommendation of the Secretary of the Treasury another reservation of 7 acres had been similarly made as a site for a hospital for the Marine Hospital Service. Through the cour-

tesy of the Secretary of the Navy, this Department has been granted the temporary use of the naval hospital site for experimental purposes. After negotiations with the government of the Territory of Hawaii, the larger portion of the Kewalo-uka tract was definitely set aside for the use of the experiment station to be conducted under the direction of the Secretary of Agriculture in the proclamations issued by the acting governor of the Territory.

About 50 acres of land have been cleared, and half of this area has been plowed and harrowed. This includes $13\frac{1}{2}$ acres of forest land on the upper portion of the reservation, where there is sufficient rainfall to make it possible to carry on experiments without irrigation. This will be devoted to horticultural plantations, and in this way will be covered with trees again. A water system has been provided by the erection of several large tanks, which are connected with the city water system and operated with the aid of a gasoline engine and pump. The following buildings are in process of erection: Residence for the special agent in charge, office and laboratory, one frame cottage and two grass huts for laborers, one stable, and one covered manure pit.

Plantings of taro have already been begun, with the special object of studying a disease which plays havoc with that crop. This is a very important matter, since the taro is a principal food plant of the islands. Every part of the plant is eaten at some stage of its growth. The root is large, fleshy, and full of starch, and is exceedingly wholesome and palatable. It grows in marshy lands in the valleys, but there are also varieties suited to upland cultivation. Probably 50 per cent of the working population in these islands depend on taro for their daily food. The fungous disease above referred to cuts down the yield to one-fourth or one-third of the normal average, and is all too prevalent. Within the last decade the price of taro has increased 500 per cent because of the losses by this disease and the attendant deterioration in quality and yield. There are many other fungous diseases of fruits and vegetables prevalent on the islands in Hawaii which should be studied.

Some poultry experiments have also been inaugurated. These could be undertaken immediately without great expense, and it is hoped that they may lead to results of immediate practical usefulness. Largely because of the great number of diseases with which barnyard fowls are afflicted in the Hawaiian Islands the supply of poultry does not meet the demand. Live chickens sell in Honolulu markets for \$15 a dozen and eggs at from 40 to 50 cents a dozen. If the station can demonstrate a practical way for the economical production of chickens and eggs it will add largely to the resources of the small farmers on the islands.

Owing largely to the insufficient supply of forage, pork production is very expensive, the ruling price for hogs in the Honolulu markets being from 10 to 17 cents per pound on the hoof. To remedy this difficulty experiments with various tubers and roots and with the common papaya as feed for swine will be undertaken at an early day.

As soon as possible investigations in dairy husbandry will be undertaken. On this subject Mr. Smith reports as follows:

Dairying and cattle feeding is now being carried on on a small scale with some measure of success, but the supply of milk and butter is insufficient to meet the demands of the home trade. Island butter retails for 60 cents per pound, milk for 12 cents a quart, and Hawaiian-made cheese is almost unknown in the Hawaiian markets. A few of the dairies are managed on a scientific basis.

There is, however, widespread ignorance of the best combinations of feeds and

too great dependence on one-sided rations both in feeding dairy cattle and in fattening animals for the shambles. The use and necessity of leguminous forage plants is not recognized. Enough by-products of the sugar plantations are burned every year to feed all the beef, pork, and mutton consumed in the islands.

Experiments should be conducted in the utilization of the waste cane tops in the form of silage for feeding dairy cattle and beef steers, and with the waste molasses for fattening sheep, cattle, and hogs. On some plantations the work horses and mules are fed cane tops and molasses to good advantage. The practice can with profit be extended to other branches of animal husbandry. But it is of even greater importance that extensive experiments be carried on with forage plants rich in protein, the clovers and beans, to supplement and fully utilize all of the heat and fat-making energy of the cane-top and sorghum rations generally used. The Hawaiian Islands can grow and fatten more than enough animals to supply the home demand. At present considerable importations of cattle, beef, mutton, hogs, and pork are made from the mainland, Australia, and New Zealand. On the contrary, because of the location of the group, Hawaii ought to be able to command a superior market for all her surplus dairy and meat products in the Orient.

Plans are being made for experiments in horticulture, including both fruits and vegetables, and coffee culture. These will include experiments with reference to the methods and times of pruning, methods of cultivation, picking, and marketing, as well as tests of varieties. To show the importance of such investigations, Mr. Smith makes the following statements:

The Hawaiian Islands market depends largely on supplies of fruits from the mainland at all seasons of the year. Not only can enough fruit in sufficient variety be grown to supply the local markets, but both fruit and vegetables might be grown for export. The Honolulu market is usually well supplied with fruits and vegetables, though not always of the best quality nor in large variety, but the plantations, farms, and ranches depend largely on canned products. Work to show the practicability of the growing of a wide range of fruits and vegetables for the home table at a distance from well-filled markets will be profitable and desirable.

It is hoped that experiments in coffee culture and the growing of various spices and drugs may also be undertaken at an early day. On this subject Mr. Smith reports as follows:

Probably \$10,000,000 has been sunk in unprofitable coffee cultivation in these islands during the last ten years. An intelligent investigation of all phases of the coffee industry will well repay. Coffee is a white man's crop. It is grown at elevations unsuited to cane and where the climate is admirably adapted to a comfortable and healthful existence.

The coffee lands of Hawaii can be made as productive as any in the world. Experiments in the selection and crossing of varieties to produce more prolific or hardier trees, and especially an investigation of the methods of curing coffee, should be made in an effort to save this industry. Hawaiian coffee has already made for itself an enviable reputation for quality and flavor of berry. If it could be sold on its merits instead of in competition with the low-grade coffees of Brazil and Central America, it would in time prove an immensely profitable crop. An effort should be made to save this industry from total extinction. It is a crop especially suited to the small farmer and the small investor—the man who can build up a home and care for his crop himself. The establishment of the coffee industry on a successful basis would make the Hawaiian Islands a land of small farmers more quickly than the transformation could be accomplished in any other way or through the medium of any other crop or industry. Besides coffee, various spices and drugs could be grown, such as pepper, allspice, ginger, cardamom, cloves, various tannins, kinos, and oils. But with all of these the experiment station must lead the way and show the possibility of profitable culture before the farmers are advised to undertake the cultivation.

Investigations on methods of cultivation and the use of fertilizers and drainage and irrigation are also much needed. On this point Mr. Smith states:

Very little has been done to demonstrate the value of thorough cultivation and the use of commercial fertilizers except in connection with sugar cane. There is

a wide field for work in these two lines. It is a recognized principle that a cane field must be well prepared and a cane crop well cultivated and fertilized to secure the best and largest yields, but with almost all other crops it is taken for granted that the tropical climate will bring the plants to full fruition alone, without adequate cultivation or the use of fertilizers. Water is poured on lavishly and the sunshine and normal high temperatures are expected to do the rest. Problems in soil cultivation, fertilization, drainage, and irrigation must be investigated in their relation to other crops than sugar.

Investigations in forestry are much to be desired, but these can not be undertaken by the station without considerable increase in its resources; and in any case, whatever investigations the station might undertake in this direction should be done in cooperation with the Bureau of Forestry. Regarding this subject, Mr. Smith makes the following statements:

Many of the native woods of this group are extremely valuable from a commercial standpoint and a considerable trade in these woods, notably koa and sandal, at one time flourished. I would recommend that the entire backbone of each main mountain chain of each of the islands be set apart in forest reserves under the Federal Government, in order that the native forests may be protected and preserved and that a modern and legal system of forest conservation may be carried out. The sugar plantations all depend directly or indirectly on the wooded mountain slopes for their water supply, and it is due to their owners that something be done to check the further destruction of the native forests, and also to replant large areas with trees (native and foreign) which shall in the future become commercially valuable.

Considering the variety of subjects for investigation, the annual appropriation for the maintenance of the Hawaii experiment station should be not less than \$15,000. To properly equip it with buildings, apparatus, implements, live stock, etc., a special appropriation of \$10,000 is very much needed. It was hoped that the legislature of the Territory would follow the example of the other States and Territories in supplementing the National funds for the maintenance and equipment of the station, but though measures looking to this end were introduced they failed to pass.

PORTO RICO EXPERIMENT STATION.

The first appropriation for agricultural investigations in Porto Rico was made for the fiscal year ended June 30, 1901. This appropriation was \$5,000 and authorized the Secretary of Agriculture to determine the agricultural conditions existing in that island with special reference to the most desirable localities for agricultural experiment stations, as well as the subjects on which the agricultural people of the island are in most immediate need of practical information, and how this need can be most economically and effectively supplied; but it did not provide for the establishment and maintenance of an experiment station. The preliminary investigation called for by this appropriation was made through this Office by Prof. S. A. Knapp, formerly of the Iowa Agricultural College, and more recently engaged in agricultural enterprises in southern Louisiana. He visited Porto Rico during the summer of 1900 and made his final report in September of that year. This report was transmitted to Congress and published as House Doc. No. 171 (Fifty-sixth Congress, second session). It contains a summarized statement regarding the climate, soil, and agriculture of the island, shows in what ways the experiment station might benefit agriculture, and recommends the establishment of a station as soon as practicable. Professor Knapp advises that the station should give immediate attention to promoting the production of

larger and better crops of coffee, sugar, and tobacco, and food products for home consumption, and that at an early day work should be undertaken in horticulture, forestry, animal husbandry, and dairying. Besides conducting experiments, it should give object lessons in improved farming and should disseminate information by publications and agricultural meetings.

On the basis of this report Congress made a second appropriation (\$12,000) for the current fiscal year, which authorized the Secretary of Agriculture "to establish and maintain an agricultural experiment station in Porto Rico, including the erection of buildings, the printing (in Porto Rico), illustration, and distribution of reports and bulletins, and all other expenses essential to the maintenance of said station."

Though this appropriation did not become available until July 1, 1901, Mr. Frank D. Gardner, assistant in the Division of Soils, was transferred to this Office April 15, 1901, and was appointed to take charge of the agricultural investigations in Porto Rico. After spending some time in such preliminary preparations for the establishment and maintenance of an experiment station in Porto Rico as could best be conducted in Washington and vicinity, he proceeded to Porto Rico, arriving in San Juan about the middle of May. The remaining portion of the fiscal year he spent mostly in traveling about the island to familiarize himself with its people and the conditions and needs of agriculture, with special reference to the location of the experiment station and the character of experiments most desirable to undertake. During a portion of this time he was accompanied by Messrs. O. F. Cook and G. N. Collins, of the Division of Botany, who had been temporarily assigned to this Office, and sent to Porto Rico to aid in preliminary studies with reference to the determination of the best lines of work for the proposed experiment station. Mr. Gardner has made the following brief preliminary report on his observations in Porto Rico during these journeys:

To the tourist the island is indeed most attractive and beautiful. This is particularly true of the interior and mountainous parts, which constitute somewhat more than three-fourths of its total area. As a winter resort for tourists from the States and elsewhere it has great possibilities. Better and quicker water communications between the island and States, good hotels at a number of suitable points on the island, and easy communication between them, are the chief requisites which are wanting in order to make the island a most attractive and popular resort.

From the standpoint of the agriculturist there are also good possibilities, but in some respects there are also adverse conditions which present grave difficulties to agriculture, at least when considered in its intensive form.

Chief among these are the rough and rugged topography of much of the land surface, which prohibits in a large measure the use of modern machinery; the torrential character of many of the rains, which in case of cultivated land tends to wash away the surface soil, much to the detriment of the fertility of the land, and then the heavy texture of the soil, which in a wet climate often renders it unfit to cultivate for long periods of time, to the advantage of weeds and to the detriment of crops. Last, but not least, is the lack of roads by which the products of the land can be taken to market.

At present there are areas of 50,000 acres in one body which are inaccessible except on horseback or on foot, and from which the only means of transporting the products is either on the backs of mules or upon the heads of peons. Much money has been spent on roads during the past year and much will be spent the coming year, so that the road question is in a fair way to be solved in time.

The soils of the island vary greatly. About the seashore there is usually present a sandy border varying from a few hundred feet in width to several miles in other places. This is a coarse, light-colored coral sand, and is best adapted to coconut palms and pineapples. Between the sandy lands and the mountainous interior occur quite extensive areas of level alluvial lands, which constitute the principal sugar lands. These areas are most extensive near the mouths of larger

rivers, and usually become quite limited midway between them. The sugar lands vary in texture from sandy loam to clay loam, and are as a rule quite productive. Considerable of this land is too wet, especially during the rainy season, to give good results in cane. Much of it is used as pasture land. By adequate drainage this land could all be used for sugar, and its value increased from \$30 to \$60 per acre as pasture to \$100 to \$150 per acre as sugar land.

The soil of the sugar lands on the south side of the island is of different origin than that on the north and is deeper, darker, and more sandy. Owing to much less rain there irrigation is necessary.

The acreage in sugar the past year was approximately 80,000, giving an estimated yield of about 90,000 tons. This acreage can be at least doubled, and the yield trebled. The past season has been a prosperous one for the growers, and next year will see the area much increased. Both American and local capital is being put into large new sugar houses, which will replace a large number of the old and wasteful mills that have long been in use. The outlook for sugar is excellent.

The soil of the mountainous interior is usually heavy in texture, although small areas of sand land occur, especially along the streams. The interior country is adapted to coffee, bananas, citrus fruits, and minor crops. Tobacco does well on the sand river lands, and also on some of the steep hillsides.

Of all the industries in the island, none received such a severe setback by the cyclone of 1899 as did coffee culture. The damage to coffee exceeded that of all other crops in the island. Many of the plantations are still in a state of ruin, while others were cleared and put in shape and at the present time have nearly a normal crop. The method of growing coffee is exceedingly crude: there is usually too much shade and the plants are set at unequal intervals and too close together. Very little cultivation is given, and no attention is given to the selection, propagation, and pruning of the trees. By attention to these points great improvement can undoubtedly be brought about in the production of coffee, and the actual cost of production can be much reduced.

Cattle do well. They feed on the luxuriant pastures the year round, grow and become fat enough for market with no additional feed. They are but little bothered by flies and other insects, and seem to enjoy comfort the entire year. As work oxen and beef cattle, the breed commonly found on the island seems a very good one, but as milkers they are poor, giving only a small flow of milk, which contains a low percentage of fat. With an extension of the sugar lands and the new impetus which coffee, fruits, and minor crops are likely to receive in the next few years the large areas of pasture are likely to be much decreased, so that the live-stock interests are likely to be reduced rather than increased. Coffee, fruits, and tobacco and the minor crops, and to some extent dairying, should receive the early attention of the station.

As regards the location of the experiment station, more difficulty was experienced in obtaining suitable land than was anticipated. As there is no Government land available it will be necessary either to purchase land with funds appropriated by Congress or to secure financial assistance for this purpose from the insular government or municipalities. There will be no opportunity for getting financial aid from the insular government until the meeting of the legislature next winter. In reply to a circular letter sent to the different municipalities in the island, setting forth some of the advantages of an agricultural experiment station, and asking how much land they would donate for the purpose of establishing an experimental farm in their vicinity, replies, as a rule, stated that the municipalities possessed no lands that in kind and amount would be suited for the purpose, and that their very poor financial condition would not allow them to purchase. Three municipalities, however, made offers of land, but on examination it was found that the land was either not suitable for experimental purposes or too inaccessible. Negotiations are being continued in this matter, but it does not at this time seem probable that land can be obtained without the expenditure of a larger amount than can be used for this purpose from our present appropriation. I am of the opinion that final action on this matter should be deferred until after the meeting of the insular legislature, when an effort should be made to secure local financial aid in the establish-

ment of the station, as in the case of other Territories. I see no good reason why the government of Porto Rico should not supplement the National funds for an agricultural experiment station in the same way. Meanwhile, the headquarters of the station will be maintained at San Juan, and such investigations will be undertaken as can be pursued on lands leased or loaned by residents of the island desiring to engage in cooperative work with the station.

Information regarding the agricultural needs of the island and methods which may be adopted for the improvement of agriculture on the basis of our present knowledge will be collated and published, and the people will be aided in this and other ways to improve the agricultural conditions. Efforts will be made to institute experiments in the culture of coffee and citrus and other fruits. Experiments are much needed to discover effective methods for the extermination of the "changa," a mole cricket that does great damage to many crops. There are also forms of plant lice and scale insects very injurious to coffee and citrus fruits, which should be studied with reference to their repression.

Every effort will be made to expend the funds at present available in useful investigations and in the dissemination of information of value to the agricultural people of Porto Rico. As soon as the question of the location of the station is settled, it is hoped to proceed rapidly with the erection of buildings, the equipment of the station with apparatus, implements, and live stock, and the making of horticultural and other plantations, as well as the institution of experimental inquiries which will place this station on a par with the others in the United States. For the regular maintenance of an experiment station in Porto Rico, as elsewhere, not less than \$15,000 will annually be required, and I therefore recommend that Congress be asked to appropriate this sum for this station for the fiscal year beginning July 1, 1902.

AGRICULTURAL INVESTIGATIONS IN THE PHILIPPINES.

In my report for 1899 the suggestion was made that as soon as peace and order were established in the Philippines, provisions should be made for an investigation there to determine the needs of the agriculture of those islands and the ways in which these could best be met by the establishment of agricultural experiment stations. With the establishment of civil government over a considerable area in the Philippines the time seems to have arrived to renew the suggestion. In order to determine in a preliminary way the conditions heretofore existing in the Philippines with reference to agriculture and agricultural investigations, I called upon Dr. W. H. Evans, of this Office, to examine Government reports and other works bearing on these subjects and to prepare a summary report thereon. I present his report herewith:

Agriculture in the Philippines does not seem to have prospered as would have been expected in a country possessing such fertile soils and diversified climate. At some time in the history of the islands there have been successfully introduced nearly every important agricultural industry of tropical and temperate climates. After flourishing for a while many have been almost entirely abandoned. To-day a few staple crops are grown to a considerable extent, but of such an important crop as rice, the bread of the islands, not enough is produced to supply the local demands. The growing of rice is better understood by the people at large than any other crop, yet by their primitive methods of culture and crude machines they are unable to supply their own necessities. Of agricultural products, mostly food stuffs, up to 1890, there were imported annually more than \$1,000,000 worth,

while the exports amounted to about \$14,000,000, principally hemp, sugar, coffee, and tobacco.

A great number of reasons have been assigned for the limited development and retrogression in agriculture. The native people seem to possess little ambition, and are content when their limited requirements are supplied. They grow a little rice, plant a patch of sweet potatoes, and for their other necessities depend to a great degree upon the natural products of the islands. Lack of transportation facilities has been generally considered one of the most serious drawbacks to the development of agriculture. But few roads have been constructed throughout the islands and most of these become almost impassable during the rainy season. Without transportation facilities between the producer and the market, there is little incentive to the growing of bulky crops. A lack of knowledge relating to the proper growing of crops is another drawback. Aside from the production of the so-called manila hemp, the most important agricultural products of the islands are from crops the cultivation of which was introduced by the Spaniards. In the growing of one or two of these, considerable proficiency has been shown, but even for these the crudest, most primitive implements are employed. The principles of agriculture seem wholly unknown, and only a little knowledge regarding the practices as relating to a few crops is followed. Improved machinery is almost unknown and wholly unemployed. Lack of capital, without which no industry can flourish, and the very high rates of interest exacted, tend to prevent the development of small farms and minor industries. Large plantations can obtain loans upon much more favorable conditions than small ones, the titles to which are often defective.

Various attempts have been made to develop the resources of the country. In 1782 a monopoly of the tobacco industry was decreed in several provinces, and a forced cultivation of that crop was attempted. Each family was required to grow and deliver to the Government a certain quantity of tobacco each year, receiving for it a sum determined upon by the officials in charge of the monopoly. Either under private or governmental monopoly this continued for a century, with varying success. In 1882 the monopoly was abolished, and in ten years the exports increased more than 50 per cent. In 1784 a company was chartered by royal decree which gave almost absolute control of the mercantile affairs of the islands to this syndicate. This company, the Real Compañía de Filipinas, was required to expend 4 per cent of its net proceeds upon the development of agricultural resources of the archipelago. Stimulated by the large amount of money expended and the prospect of more to come, many enterprises were begun which flourished for a time. Sugar, coffee, and tobacco plantations were extended on all sides. Indigo, silk, cotton, cocoa, condiments (pepper, cinnamon, allspice, cloves, etc.) were produced in considerable quantity, and their production seemed well established. A lack of technical knowledge of the industries, coupled with special concessions granted to the city and merchants of Acapulco, Mexico, and those assumed by various provincial governors down to 1844, served to nullify all the projects of the company, causing its final downfall. A number of enterprises that were begun under the stimulus of this bounty have since retrograded, until now they are of comparatively little importance. Notably true is this of the production of rubber, indigo, cotton, silk, and condiments. Among the natives the present status of agriculture seems to be limited to the production of a few food stuffs, and these, with fruits which can be obtained from the forest, supply the necessities of life, while manila hemp is resorted to to provide ready cash whenever any is needed. There is always a market for this fiber, and it is purchased in any amount, a few pounds being easily brought to market, and the purchase price supplying the temporary requirements of the seller.

On November 15, 1881, there was organized as a sort of adjunct to the department of forest inspection an agricultural society, but the two were separated after an existence of about three years. On July 8, 1884, it was decreed that "in the future the agricultural department should be independent of the inspector-general of state lands, and should remain in charge of an agricultural commission, whose organization, object, functions, and duties were determined in regulations approved by the sovereign." These regulations required a study of agriculture, animal production, and the means leading to their improvement, theoretical and practical teaching of agriculture and animal culture, the preparation of reports relating to the above, editing of monographs with reference to the agriculture of the archipelago, and the making of agricultural and other collections for local museums. A royal decree issued November 26, 1887, established a school of agriculture at Manila, and in 1888 the budget, as given by Foreman in his work on the Philippine Islands, provided \$113,686.64 for the support of this school and model farms which had been established in different provinces about this same time. According to the decree establishing a school of agriculture, attention was to be given to,

"first, the determination and study of the physical properties of the tillable soils of the region; second, mechanical analysis of the same; third, physical-chemical analysis of the same; fourth, qualitative analysis of the same; fifth, analyses and experiments by the scholars and their employment in actual practice; sixth, study of systems of irrigation, quantity and quality of water, epochs and times of irrigation best adapted to cultivation; seventh, analysis and study of seeds, methods of sowing and grafting; eighth, study and analysis of secondary products of agricultural products and their uses; ninth, experiments with classes of labor, and with machines and instruments best adapted to cultivation; tenth, experiments with new kinds of products, and studies of their adaptability and cultivation; eleventh, study of the climate and its action upon products, of the natural fertility of the soil, the assimilation of atmospheric and other elements, and the manner of changing them; twelfth, study of the expense and products of actual cultivation and of reforms in the economy of production; thirteenth, studies with reference to herds and their races, qualities, feeding, care, and the acclimatization of new species and breeds; fourteenth, study of agricultural industry, industrial products, machinery, and reforms in industrial methods; fifteenth, study of the diseases or pests affecting crops and animals and the means of combating them and conserving products; sixteenth, solution of all other problems of technical or economical character which affect, or may affect, the agriculture of the region."

In addition to the above, agricultural instruction was given in the University of Manila and at the Municipal Atheneum. The laws under which they were conducted required that the directors and professors of the schools and farms should be agricultural engineers, with skilled graduated farmers for their assistants. In 1887 the first model farm in this system was established at La Carlota, near the principal center of agricultural activity of the archipelago. A little later a second was established at San Pedro de Magalang, Luzon. After 1888 this station paid especial attention to horse breeding, a stud of Arabian horses being maintained for crossing with the smaller horses of the islands. Other stations were maintained at Albay, Isabela Luzon, Iloilo, Ilocos Sur, and at Cebu. Stations were also established at Jolo and Leyte, but were discontinued September 10, 1888, and December 7, 1891. These stations were designed to show what cultures could be successfully maintained in their vicinity, and received a limited number of students, who were trained as overseers for large plantations. Since January, 1894, there has been published an official journal entitled *Boletín Oficial Agrícola de Filipinas*. It was designed to give accounts and to place on record the various investigations undertaken at the agricultural schools and stations. A few numbers of this bulletin have been received at the Library of this Department, but they give little data regarding the work done, the principal articles being reprints or reports of agriculture in other countries. Since the American occupation of the Philippines but little appears to have been done in the maintenance of these schools and stations. At least, the available information regarding education does not mention at all, or but briefly, the subject of agricultural instruction in the islands. That the Philippine Commission is alive to the necessity of the subject is shown by the fact that it has established a bureau of forestry, which is placed in charge of a competent officer with a corps of assistants, and examinations have been held by the United States Civil Service Commission to supply a register for instructors in agriculture and some of its allied branches. The necessity for the introduction of modern methods of cultivating and handling crops is apparent to anyone who reads any of the numerous publications which treat at all fully of the conditions existing in the islands. But little stimulus would be required to restore many of the almost abandoned industries to a state in which they would be remunerative, and the possibilities of extending the cultivation of such crops as rice, sugar, coffee, and tobacco seem to be almost unlimited, if the reports at hand are to be believed.

It would, in my judgment, be best to confine the preliminary investigation in the Philippines within the area of the islands controlled by the civil government, and to limit it to such studies as are necessary to determine the most suitable location for an experiment station which could at once take up a few lines of work of the most pressing importance. With headquarters for agricultural investigations once established, and a single experiment station well organized, it would be easy to extend the work of agricultural research so that it would take into account the special needs of different localities. I therefore recommend that an initial appropriation of \$15,000 be made to enable the Secretary of Agriculture to institute agricul-

tural investigations in the Philippines and to locate and maintain an agricultural experiment station there. In order that these investigations may be begun at an early day, one-third of this amount should be made immediately available.

NUTRITION INVESTIGATIONS.

The investigations on the food and nutrition of man, carried on in different parts of the country, have been continued during the past year, with Prof. W. O. Atwater as special agent in charge. The headquarters for these investigations have remained at Middletown, Conn., where the work is carried on in cooperation with Wesleyan University and the Storrs Experiment Station.

As in previous years, the work is done largely in connection with the experiment stations, colleges, and universities, some of the leading institutions in the country being represented among the co-operators. This policy secures the services of skilled investigators, utilizes the resources of the institutions, secures an amount of valuable research very large in proportion to the cost, awakens widespread interest, and helps to give large and useful publicity to the results.

Following is a list of the co-operators during the year, and of the institutions with which they are connected:

Maine: State University and Experiment Station, Prof. C. D. Woods and associates.

Massachusetts: Harvard University, Dr. E. A. Darling, Mr. Edward Mallinckrodt, jr.

Connecticut: Wesleyan University and Storrs Experiment Station, Prof. W. O. Atwater and associates.

New York: Columbia University, Dr. H. C. Sherman.

Tennessee: State University, Prof. C. E. Wait and associates.

Illinois: State University, Prof. H. S. Grindley.

Minnesota: State University and Agricultural College, Prof. Harry Snyder.

California: State University and Experiment Station, Prof. M. E. Jaffa.

The publications of the year have also included work of the following: North Dakota—State Agricultural College, E. F. Ladd; Ohio—Lake Erie College, Miss Isabel Bevier.

GENERAL PURPOSE AND PLAN OF THE INVESTIGATIONS.

The nutrition investigations the past year may be divided into four general classes: (1) Dietary studies; (2) digestion experiments; (3) cooking experiments; (4) metabolism experiments.

The dietary studies have been conducted in various parts of the United States, and have included the study of the diet of people of varying ages and occupations under different conditions. They furnish a considerable amount of data as to the actual food habits of persons in different parts of the country, give opportunity for comparison with the data obtained in other countries, and aid in establishing a general nutrition standard.

The digestion experiments have also been conducted in different parts of the country under widely varying conditions. By means of these experiments the digestibility of various classes of food materials, like meats, cereals, legumes, fruits, nuts, etc., is studied and data are obtained as to the amount of the food material consumed which is made available for use in the human body.

The cooking experiments have been made with meat, and have included the study of the effects of different methods of cooking upon

the meat with reference to composition, digestibility, nutritive value, and pecuniary economy.

The metabolism experiments have been conducted mostly at Middletown, with the aid of the respiration calorimeter. In these experiments the income and outgo of the body were carefully observed under different conditions of rest and work. The questions especially considered this year were (1) the relation between muscular work and the metabolism of nitrogen, and (2) the relative efficiency of fats and carbohydrates in the diet for severe muscular work. The results obtained have been unusually interesting and valuable.

All these experiments include a large amount of analytical work as well as the determination of a considerable number of heats of combustion by means of the bomb calorimeter.

Considerable editorial work is also required to put the results of the investigations in form for publication as either technical or popular bulletins. The amount of editorial work has been somewhat larger this year than usual.

THE WORK AT DIFFERENT PLACES.

The work of the Washington office in relation to the nutrition investigations during the past year has included a general supervision of the plans and expenditures; editorial work in perfecting the details of reports of investigations; collection of bibliographical data; the abstracting of the literature of nutrition, partly for publication in the Experiment Station Record; the conducting of a large correspondence growing out of the nutrition investigations, and the distribution of publications on this subject.

The work of the office of the special agent in charge of the nutrition investigations at Middletown, Conn., has included the planning and direct supervision of these investigations in different parts of the country, the conducting of special investigations with the respiration calorimeter and bomb calorimeter, the compilation of the results of nutrition investigations in this country and abroad, and a large correspondence relating to these investigations. The special investigations carried on here the past year in cooperation with Wesleyan University and the Storrs Experiment Station have included an unusually large amount of experimental work with the respiration calorimeter. The principal objects of these investigations were to study the relation between muscular work and the relative efficiency of fats and carbohydrates in the diet for severe muscular work. Other observations made were of the amount of heat liberated by the body during the period of digestive inactivity as compared with the period when digestion is going on, the metabolism of nitrogen during fasting, and variation of body temperature under different conditions. Four series of experiments, covering a period of nine days each, and a shorter series of five days, were conducted during the year. With but one exception, each series included three experiments—two of four days each, followed by one of one day. During the first two experiments of the longer series the subject performed severe muscular labor, riding a stationary bicycle eight hours in the day. In one of the experiments a diet rich in carbohydrates was given to the subject, while in the other a diet rich in fats was provided, the amounts of protein and energy being essentially the same, as well as the amount and character of the work. Two pairs of experiments were followed by an experimental day of rest and fasting. Two other pairs were followed

by an experimental day in which the diet was changed, while the amount and character of the work remained the same. The short series included one experiment of four days, in which the subject did not work, followed by an experimental day of rest and fasting. The measurements of outgo of carbon, hydrogen, and energy were made in two-hour periods, and the results will serve to show the relation of elimination of these to the character and amount of work done. The three fasting experiments throw some light upon the amount of energy required for digestion. The general results of the experiments are of unusual interest and importance. They attest the validity of the statement previously made that these experiments go a long way toward proving the application of the law of the conservation of energy in the living organism, if they may not be taken as practically proving it. The results also appear to show a very slight difference in the value of fat and sugar as a source of energy for muscular work in favor of the sugar.

In connection with this experimental work, 16 digestion experiments have been made, 67 complete and 407 partial analyses of food and excretory products were made, together with over 100 determinations of heats of combustion of food materials and excretory products, by use of the bomb calorimeter.

Some new apparatus has been devised and changes and improvements adopted which give increased efficiency. By means of a specially devised thermometer for determining the internal body temperatures, which has been in use the past year, temperature observations have been secured which will constitute an important addition to the value of the work done.

At the request of the acting superintendent of the Elmira Reformatory, Elmira, N. Y., a study was made by some of our assistants in Middletown of the dietaries of the inmates of that institution. This study, while necessarily very limited in scope, gave results of some value, and was of special interest as showing the possibilities for such work and the need of investigation along this line.

Under direction from Middletown, a study was made last year of the dietaries of ten students at Harvard College by Mr. Edward Malinckrodt, jr., with the cooperation of Professor Sanger. Some of these students are obliged to live very economically and their food consumption was quite limited. The studies were carried on during three periods of three weeks each, one in the late fall, one in winter, and one in late spring. Records of the physical condition of the subjects were made during each experimental period. The data of the investigation will, it is expected, serve as a valuable contribution to the subject of the food consumption of sedentary persons. The dietary and digestion experiments with members of the Harvard boat crews at New London, begun last year, and carried out with the cooperation of Dr. E. A. Darling, have been completed.

Besides the investigations for this Department, several other lines of nutrition investigations are carried on at Middletown under Professor Atwater's supervision.

The experiments referred to in my last report as being conducted under the auspices of the committee of fifty for the investigation of the drink problem have been completed. While this work is entirely independent of the Department of Agriculture, still the material thus gained will prove of much value in connection with the general nutrition investigations. Indeed, the main results of the experiments are independent of those relating to the action of alcohol. The investi-

gations also referred to in my last report as being carried on by authority of the New York State commission in lunacy, for the purpose of establishing a standard dietary for use in the hospitals for the insane in the State of New York, have been continued during the past year. A number of dietary studies have been made in the New York hospitals. Much attention has been directed to preparing the results of the investigations for practical use and publication. These results, also, will prove a useful contribution to the knowledge already gained of the general subject of the nutrition of man. The investigations have attracted considerable attention, especially among those interested in sociological and economic questions, and may lead to broader and more extended investigations along these lines.

In Maine, Prof. C. D. Woods, at the University of Maine, Orono, has been comparing the digestibility of breads made from Northwestern wheat milled in different ways. This was a repetition of the experiments conducted the previous year in order to verify and substantiate the results then obtained. Straight patent, so-called entire wheat, and graham flours were used, and nine digestion experiments, with three subjects, were made. Three experiments were conducted with each subject with the different flours, and included considerable analytical work. Considerable work has also been done with Maine wheats milled in different ways. In addition, two digestion experiments were made with chestnuts, and a long series of studies were carried out with different materials as markers, for the purpose of perfecting a method for obtaining more accurate results in digestion experiments. The work on the different kinds of flour is of great practical importance and has added much to the knowledge of the relative digestibility of the nutrients of these three flours, a subject which has been much discussed.

In Minnesota, Prof. Harry Snyder, of the Agricultural College of the University of Minnesota, St. Anthony Park, has been cooperating with Professor Woods in the experiments with flour. The opportunity for work of this kind in that section is especially favorable, since it is in the center of the milling district of the Northwest, and most fortunately some of the great milling establishments, finding the inquiry of decided practical value, have offered unusual facilities for experiments upon the milling products and bread made from them. Nine digestion experiments with three different subjects have been made with straight patent, so-called entire wheat, and graham flours. These flours were all milled from the same lot of wheat and were duplicate samples of those used by Professor Woods, and the experiments were parallel in every respect.

In Illinois, Prof. H. S. Grindley, of the University of Illinois, Champaign, has continued his investigations on the digestibility of meats, as determined by natural and artificial digestion experiments, and the losses involved in different methods of cooking various kinds of meat. These were in continuation of the investigations conducted the two previous years, a report of which is soon to be published. Fifteen cooking experiments were made, in which the results obtained in frying and boiling were compared, beef being the meat generally used. The experiments included the analysis of a considerable number of cooked meats, clear broth, and the coarse and fine residues obtained from meat broths. Thirteen natural digestion experiments with men were also made, in which meat formed a large part of the diet. These experiments included a large amount of analytical work with food and feces and the determination of the nitrogenous material in several

samples of feces soluble in pepsin solution. Considerable work was also done upon the artificial digestion of meats, this, however, being largely preliminary to work to be done later. In addition, the heats of combustion of fifty samples of foods and excretory products in duplicate were determined. Finally, an inquiry has been undertaken regarding the so-called extractives in meat.

In Tennessee, Prof. C. E. Wait, of the University of Tennessee, Knoxville, has been investigating the dietary of poor whites in eastern Tennessee and the digestibility and availability of the nutrients of legumes. Six dietary studies were made with typical families of white people of limited means, and interesting results were obtained. For the experiments on the digestibility of legumes, beans were selected, and eight digestion experiments were made, including one metabolism experiment. These were not less than four days in duration, and were made for the purpose of determining not only the digestibility and availability of the nutrients of the legumes, but also the effect of rations of wide nutritive ratio as well as those of rather narrow nutritive ratio upon the digestibility of protein and the metabolism of nitrogen.

In California, Prof. M. E. Jaffa, at the University of California, Berkeley, has been making special investigations as to the food value of fruits. Nine dietary studies were made and one digestion experiment, which also included a metabolism experiment. The subjects of the experiments were five fruitarians, two women and three children, whose diet had been for a long time almost wholly composed of fruits and nuts. They appeared to be in excellent health, and claimed to be better than when they lived upon a mixed diet. The food was all eaten raw, and the total quantity of nutrients was very small in comparison with ordinary dietary standards. The digestibility of the diet appeared to be as great as that of an ordinary mixed diet.

FOOD AND NUTRITION PUBLICATIONS.

Seven technical bulletins, two Farmers' Bulletins, a Yearbook article, and two circulars on subjects relating to the food and nutrition of man were prepared for the press during the past year, making in the aggregate 450 to 500 pages of printed matter on this subject.

Nutrition Investigations at the California Agricultural Experiment Station, 1896-1898, by M. E. Jaffa, assistant professor of agriculture, University of California (Bulletin No. 84, pp. 39), reports four dietary studies of infants, one of the university football team during training, and one of a chemist's family; also digestion experiments with an infant on a milk diet, as well as a metabolism experiment in which the balance of income and outgo of nitrogen was determined.

A Report of Investigations on the Digestibility and Nutritive Value of Bread, by Charles D. Woods, director, and L. H. Merrill, chemist, Maine Agricultural Experiment Station (Bulletin No. 85, pp. 51). This bulletin is a progress report, giving the results of experiments with men on the digestibility of bread of various kinds when eaten alone and when forming a part of a simple mixed diet; artificial digestion experiments with the same sorts of bread; a test of skim milk *v.* water for use in mixing dough; and studies of the loss of nutrients in bread making and of methods of determining metabolic nitrogen.

Experiments on the Effect of Muscular Work upon the Digestibility of Food and the Metabolism of Nitrogen, conducted at the University

of Tennessee, 1897-1899, by Charles E. Wait, professor of chemistry, University of Tennessee (Bulletin No. 89, pp. 77), is a report on 16 experiments with men, undertaken for the purpose of studying the effect of muscular work upon the digestibility of a simple mixed diet and upon the metabolism of nitrogen, with numerous analyses of the food materials used in the experiments.

Nutrition Investigations at the University of Illinois, North Dakota Agricultural College, and Lake Erie College, Ohio, 1896 to 1900, by H. S. Grindley and J. L. Sammis, E. F. Ladd, and Isabel Bevier, and Elizabeth C. Sprague (Bulletin No. 91, pp. 42), reports the results of a study of the diet of a teacher's family and of a mechanics' boarding club at the University of Illinois, Champaign, Ill.; of a club of women students at the North Dakota Agricultural College, Fargo, N. Dak.; and of the faculty and students at the college commons of Lake Erie College, Painesville, Ohio, including numerous analyses of the food materials used.

The Effect of Severe and Prolonged Muscular Work on Food Consumption, Digestion, and Metabolism, by W. O. Atwater and H. C. Sherman, and the Mechanical Work and Efficiency of Bicyclers, by R. C. Carpenter (Bulletin No. 98, pp. 67, figs. 3), reviews previous investigations on this subject, and reports studies of the food consumption, digestion, and metabolism of three of the contestants in a six-day bicycle race at Madison Square Garden, New York, with a critical discussion, by the professor of experimental engineering of Cornell University, of the mechanical work and efficiency of bicyclers based upon data secured in these studies.

Beans, Peas, and Other Legumes as Food, by Mary Hinman Abel (Farmers' Bulletin No. 121, pp. 32, figs. 10). For note on this bulletin see page 200.

Eggs and Their Uses as Food, by C. F. Langworthy (Farmers' Bulletin No. 128, pp. 32). This bulletin is noted on page 200.

The Value of Potatoes as Food (Yearbook of the Department of Agriculture, 1900, pp. 337-348), by C. F. Langworthy, summarizes the available information on this subject.

There were also prepared and submitted for publication the following bulletins:

Studies on Bread and Bread Making, by H. Snyder, professor of chemistry, College of Agriculture, University of Minnesota, and chemist of the agricultural experiment station (Bulletin No. 101, pp. 65, pls. 3, fig. 1).

Experiments on the Losses Involved in the Cooking of Meat, 1898-1899, by H. S. Grindley, professor of chemistry, College of Agriculture, University of Illinois, with the cooperation of H. McCormick and H. C. Porter, of the department of chemistry of the university (Bulletin No. 102, pp. 64).

PLANS FOR NEW NUTRITION WORK.

During the present fiscal year the nutrition investigations will proceed along the same general lines as heretofore, but will be somewhat increased in amount and variety. A special effort will be made to put in form for publication a large amount of the material which has accumulated from various sources. At Middletown the experiments with the respiration calorimeter and bomb calorimeter will be continued. Plans are being made to add to the respiration calorimeter special devices for the direct determination of oxygen. It is also

planned to make investigations along this line with the smaller Rosenthal calorimeter. In Maine and Minnesota the studies on cereals will be continued. In the former, State plans are being made for dietary studies in logging camps, the conditions for such studies being especially favorable at this time. The work performed at these camps is very arduous, often covering from fifteen to eighteen hours per day of hard labor under severe conditions of cold and wet. Dietary studies under these circumstances will doubtless add much valuable information regarding the food requirements of men laboring under severe conditions. In Tennessee it is proposed to continue the digestion experiments with different legumes and to enlarge the number of dietary studies among the small farmers of that State. In Illinois the study of meats will be continued in the same lines as heretofore. Special attention will be given to the experiments on the effects of different methods of cooking on the nutritive value and digestibility of meats. The facilities offered for this work at the University of Illinois have been much improved and the funds allotted by this Department for this investigation have been increased. In California the investigations on the dietetic value of fruits will be continued on a larger scale than previously, including both dietary studies and digestion experiments. The studies already conducted have aroused much local interest in California, and the University of California is cooperating heartily in this work. In Vermont the investigations in cooperation with the State University, proposed for last year but unavoidably postponed, will be conducted on a larger scale than originally planned. They will include especially the study of farmers' dietaries, with particular reference to the place of milk and dairy products in the diet. In New York, at Columbia University, a study of sulphur and phosphorus metabolism has been undertaken. This will include digestion experiments in which the income and outgo of nitrogen, sulphur, and phosphorus will be determined, and the "balance" of these elements compared. This is a new feature in these investigations.

FURTHER OPPORTUNITIES FOR NUTRITION INVESTIGATIONS.

The evidences of popular and scientific interest in the nutrition investigations of this Department continue to multiply. Scientific publications at home and abroad refer to these investigations more and more frequently and with increasing approval. The results of these investigations are being incorporated in other investigations and in scientific works on this subject, and the apparatus and methods devised by our investigators are being adopted both at home and abroad. There is a constantly increasing demand for popular and technical publications and an enlarged correspondence. Our publications are being used to an unusual extent in connection with the courses of instruction in domestic science in schools of all grades in this and other countries, and are also much sought after by women's organizations interested in the promotion of home economics and by physicians.

The lines and methods of investigation have now been so well worked out that it is believed the time has come for the wider extension of these investigations in certain directions. While a considerable number of dietary studies have been made, these have by no means covered the variety of conditions existing in different parts of this country and among people of different occupations. A more systematic and thorough attempt should be made to collect reliable data regarding the food habits of our people. We need, for example,

to study the food consumption of our farmers and rural and urban wage-workers in different regions with special reference to their hygienic and economic requirements.

It is believed that the results of nutrition investigations already made may be practically and beneficially applied in a wide way to the feeding of men wherever a considerable number of persons are to be fed on a systematic plan. This applies especially to boarding schools, college clubs, reformatory and penal institutions, hospitals for the insane and other dependent classes, and the Army and Navy. A beginning has already been made in this direction, but there is still room for a large amount of investigation before definite suggestions of general application can be made. The importance of this subject may be illustrated by reference to the hospitals for the insane in the State of New York, in which the special agent in charge of our investigations has already made some studies under State auspices. The annual cost of the food supply to these hospitals has been over \$1,000,000. The investigations already made show that not only may the total cost be considerably reduced and large wastes prevented, but that the dietaries of the inmates of these institutions may be much improved by attention to the facts and principles established by nutrition investigations. These preliminary investigations have also shown the need for more accurate inquiries regarding the food requirements of different classes of persons in these institutions. In the State of New York alone not far from 100,000 people of the dependent and delinquent classes are maintained in public institutions at an annual expense of \$26,000,000, of which about \$6,000,000 is expended for food. This will give some indication of the vast interests at stake in this matter when we take the whole country into account. Certainly here is a field of investigation upon which the Department might well enter, and in which results of great practical value might be expected.

For the extension of the nutrition investigations in the two lines above mentioned, namely, (1) dietary studies of farmers and rural and urban wage workers, and (2) studies with reference to the utilization of the results of nutrition investigations in public institutions, I recommend that \$5,000 be added to the present appropriation for nutrition investigations.

In my report for last year I called attention to the fact that investigations were needed to determine the food habits and requirements of people living in tropical countries. This matter is evidently becoming of increasing importance to our people. The continuance of soldiers, sailors, and civil officers of the United States in such regions would of itself justify the institution of investigations to determine the best dietaries for their use while there. With our rapidly expanding commerce and the going out of considerable numbers of our people to reside in tropical regions, there is additional reason for undertaking such studies. Moreover, we need to study the dietaries of the native populations which have recently come under the jurisdiction of the United States, with a view to determining the relation of their food habits to their health and industrial efficiency. Such investigations may easily become an important factor in the agriculture, trade, and commerce of these regions, as well as in the formulation of plans for the improvement of the conditions of life among these peoples. Therefore I recommend that an appropriation of \$5,000 be asked for to enable this Department to undertake studies of the food supply and consumption of people living in the Tropics.

IRRIGATION INVESTIGATIONS.

The irrigation investigations conducted under the direction of this Office have pursued the same general lines as heretofore, the work having been extended to meet the growing demand for information on this subject as far as the appropriation of \$50,000 would permit. The field office at Cheyenne has been maintained and investigations conducted from that point, the Office at Washington attending to the business which must necessarily be performed in the Department connected with the supervision of expenditures, the purchase of apparatus and supplies, the preparation of bulletins and reports for publication, and the distribution of these publications. As heretofore, the irrigation investigations have been in charge of Prof. Elwood Mead.

COOPERATION WITH OTHER AGENCIES.

As far as practicable arrangements have been made to cooperate with other agencies engaged in the study of irrigation questions. These cooperative efforts include the agricultural colleges and experiment stations of California, Washington, Montana, Idaho, Nevada, Utah, Wyoming, Nebraska, Texas, Arizona, and New Mexico in the arid region, and Wisconsin, Missouri, North Dakota, and New Jersey in the humid region. The different State irrigation offices are also being aided in the study of questions for which the States do not provide sufficient means. The cooperation with the State engineers' offices includes Nebraska, Colorado, Wyoming, Utah, and Idaho, all of the arid States in which such offices have been established.

IRRIGATION LAWS.

In accordance with the terms of the act creating this investigation, it has been continued to follow two distinct lines, (1) the study of laws and institutions of the different States relating to the ownership and distribution of the public water supplies, and (2) to assist the irrigators under ditches already built and the managers of the canals which supply the farms now irrigated in the improvement of methods of distributing and using water in order that the land now cultivated by irrigation may be rendered more valuable, the controversies over water rights lessened, and its economical use promoted.

Under the first division the investigation began by a study of the laws and customs governing the ownership and use of a single stream. It has been found desirable to modify this plan by taking up in turn the laws governing rights to water in a single State, as in this way the people of that State can better understand the merits and defects of the irrigation laws now in force and the measures necessary to avert the evils which have arisen under these laws or to promote development by their modification. The report on irrigation in California (see p. 230) is the first of these special studies of State laws. The reports of the eight experts engaged in this investigation give the most exhaustive description of irrigation conditions yet published of any State. In addition, it contains a general review of the agricultural situation and possibilities of California, written by the expert in charge, based on his personal studies. A similar investigation is now being carried on in Utah. It will include a report on Weber River by Prof. J. D. Stannard, assistant in irrigation investigations; on

Spanish Fork River by Hon. A. P. Doremus, State engineer of Utah; on the watershed of Utah Lake by A. P. Stover, assistant in irrigation investigations; on Jordan River by R. P. Teele, assistant in irrigation investigations, and an introductory review of irrigation in Utah by William E. Smythe. The increasing utilization of streams for power purposes and for the domestic supply of cities and towns, added to the greater needs of irrigation, makes the securing of some simpler and cheaper method of settling titles to water and the inauguration of a more effective system for protecting rights in times of scarcity an indispensable necessity. Hence, the results of these investigations are being awaited by irrigators with deep interest.

The studies of the operation of the Colorado laws have been continued under the direction of Hon. A. J. McCune, State engineer. The publication of his report has been delayed in order to permit of his availing himself of another season's observation of the operation of these laws. It will be published as soon as the results of this year's investigations have been completed.

THE DUTY OF WATER.

The measurements of the water used in irrigation for the past season embraced a much wider area, a better equipment, and more satisfactory results than those of the previous year. Enough time has not yet elapsed to formulate any final conclusions regarding the duty of water, but these studies have already shown the value of the information gained as a basis for the planning of the larger and costlier works which must be built in the future, a guide for the operation of canals when built and the framing of contracts for supplying water to users and for enabling the public authorities to properly supervise and control the division of streams. The location of the stations and the names of the observers in charge of the studies of water duties are given in the following table:

Official stations and names of observers.

State.	Location.	Observer.
California -----	Santa Ana River -----	W. Irving, chief engineer Gage Canal.
California -----	Tule River -----	Prof. J. M. Wilson, ¹ assistant professor of irrigation, University of California, Berkeley.
	Cache Creek -----	Do. ¹
Washington -----	Yakima River -----	Prof. O. L. Waller, professor civil engineering, Washington Agricultural College and School of Science, Pullman.
	Columbia River -----	Do.
Nevada -----	Humboldt River -----	Prof. J. D. Stannard, assistant in irrigation investigations.
	Truckee River -----	Do.
Arizona -----	Salt River -----	W. H. Code, chief engineer Consolidated Canal, Mesa.
	Salt River -----	Prof. A. J. McClatchie, Arizona Experiment Station, Phoenix.
New Mexico -----	Pecos and Rio Grande rivers	W. M. Reed, civil engineer, Roswell.
Texas -----	Colorado, Brazos, and Wichita rivers.	Prof. J. C. Nagle, professor of civil engineering, Texas Agricultural College, College Station.
Colorado -----	Arkansas and Grand rivers.	A. P. Stover, assistant in irrigation investigations.
	Big Thompson River -----	Hon. A. J. McCune, State engineer, Denver.

¹ Professor Wilson has had associated with him in these investigations A. E. Chandler, instructor in civil engineering, University of California. Prof. E. W. Hilgard, director of the agricultural experiment station, University of California, has conducted an independent investigation having special reference to the utilization of the water supplies of California.

Official stations and names of observers—Continued.

State.	Location.	Observer.
Utah	Tributaries of the Jordan River. Spanish Fork River..... Logan River.....	Hon. R. C. Gemmell, ex-State engineer, Salt Lake City. Hon. A. P. Doremus, State engineer, Salt Lake City. Prof. George L. Swendsen, professor of civil engineering, Utah Agricultural College, Logan.
Montana	Bozeman and Bitterroot rivers.	S. Fortier, director agricultural experiment station, Montana Agricultural College, Bozeman.
Wyoming	Laramie River	Eldon T. Johnston, Wheatland.
Nebraska	Loup and North Platte rivers.	O. V. P. Stout, professor of engineering, University of Nebraska, Lincoln.
Wisconsin	Stevens Point	Prof. F. H. King, professor of agricultural physics, College of Agriculture, University of Wisconsin, Madison.
Missouri	Columbia	Prof. H. J. Waters, director agricultural experiment station, University of Missouri, Columbia.
New Jersey	New Brunswick and Vineland.	Prof. E. B. Voorhees, director New Jersey agricultural experiment stations, New Brunswick.
Louisiana	Rice irrigation along Gulf coast.	Frank Bond, assistant in irrigation investigations.
South Atlantic coast.	Rice irrigation	George H. Keeney, assistant in irrigation investigations.
North Dakota	Fargo	Prof. E. F. Ladd, North Dakota Agricultural College, Fargo.

DESIGNING OF INSTRUMENTS FOR MEASURING AND RECORDING FLOW OF WATER.

The designing of instruments for measuring and recording the water used in irrigation begun by Professor Mead has continued under his direction. Two new designs for water registers were furnished to irrigators and canal companies last year. The latest of these designs can be furnished irrigators at about one-half the cost of the foreign instruments formerly used, and one instrument maker in Denver has engaged in their manufacture extensively. The first step toward economy in the use of water is to enable farmers to know whether they are receiving what they are paying for, and to insure to canal companies an accurate record of what they deliver. Since the ultimate extent of the cultivated area will be measured by the water supply rather than the area of irrigable land, the efforts to increase its duty have a direct relation to both the value of irrigation work and the ultimate area of cultivated land.

DISTRIBUTION OF WATER FROM STREAMS.

Better facilities for observation and more capable observers have permitted an extension of the studies of the duty of water so as to embrace an entire stream. Those in charge of the division of rivers know that much of the water diverted returns again; that in some places the flow of the stream sinks in the sand to again reappear on the surface lower down. Each stream has therefore problems of its own, and its behavior, as irrigation extends, must be studied and understood in order that the largest and best use of its waters may be made. Experience has shown that not only is the land along one portion of a stream much more valuable than another portion, but that its waters can be made to irrigate a much larger area in favorable sections than if unfavorable ones are chosen. The area which a

stream will irrigate in certain sections of its course can be doubled or trebled in more favorable sections. As an illustration, it may be stated that during the past season, while Snake River, Idaho, was dry at one point in its channel, at a point 40 miles below it contained over 2,000 cubic feet per second. The percentage of the volume of water used which returns to the channel of the stream helps to measure the ultimate duty of water, and in order to ascertain this, studies were inaugurated the past season to keep a record of the volume diverted by the different canals along an entire river, the volume of the original flow, and the total volume which seepage and percolation permitted to be used. These studies will not only answer the question of how much land the stream can irrigate, but will show the locations where water can be best diverted. The most extensive of these studies is being carried on in Nevada under the direction of Prof. J. D. Stannard. The next most extensive is in California under the direction of Prof. J. M. Wilson. Hon. D. W. Ross, State engineer of Idaho, has begun a similar study in Idaho, and A. P. Stover is making a special study of the same subject in Colorado and Utah.

COEFFICIENT OF FRICTION.

This investigation has also secured the interest and cooperation of a large number of irrigation engineers and managers of canal companies in a series of measurements to determine the coefficient of friction in canals and laterals, especially the latter, data for the accurate determination of the flow of small ditches being very much needed.

IRRIGATION IN THE HUMID PORTIONS OF THE UNITED STATES.

During the past two years more miles of irrigation canal have been built and more money expended for pumping plants to furnish water for irrigation in the State of Louisiana than in any of the arid States. The application of irrigation to growing rice has raised the value of large areas of land from \$5 and \$10 an acre to \$50 or \$100 an acre, and promises to make the United States an exporting instead of an importing country so far as this product is concerned. At the request of those interested, Mr. Frank Bond, irrigation expert, has been detailed to aid in the solution of the problems created by this new form of agriculture along the Gulf coast, and Mr. George H. Keeney is making similar investigations along the Atlantic seaboard. In the Mississippi Valley provision for the experimental use of water in irrigation was begun in 1900 in Wisconsin under the direction of Prof. F. H. King, and in Missouri under the direction of Prof. H. J. Waters. The work in New Jersey, inaugurated the year previous, has been continued. The severe drought of 1901 has given a more than local interest to these efforts to provide a water supply, whenever needed, for the lands of the humid States. The director of the Missouri experiment station states that their irrigation experiments are being watched by the farmers of that State with more interest than any work previously attempted by that station.

SEDIMENT INVESTIGATIONS.

The studies of the amount and character of the sediment carried by streams used in irrigation and its influence, beneficial or otherwise, on the land where applied, have been continued under the direction of Prof. J. C. Nagle, of the Texas Agricultural College. It has been

found necessary to devise special apparatus for securing samples, and this has been done under the direction of the expert in charge. The important influence of sediment is shown in the fact that as high as 34 per cent of solid matter was contained in some of the samples taken. The effects of this on the continuous operation of canals or on the enduring value of storage basins are so marked as to warrant the continuance of these studies, which has been arranged for.

IRRIGATION PUBLICATIONS.

Six technical bulletins, one Farmers' Bulletin, a Yearbook article, and a circular on irrigation, aggregating over 1,500 printed pages, have been prepared for publication during the year.

The Use of Water in Irrigation. Report of Investigations made in 1899, under the supervision of Elwood Mead, expert in charge, and C. T. Johnston, assistant, including reports by special agents and observers W. M. Reed, W. H. Code, W. Irving, O. V. P. Stout, Thomas Berry, S. Fortier, R. C. Gemmell, G. L. Swendsen, and D. W. Ross (Bulletin No. 86, pp. 253, pls. 50, figs. 18). This bulletin explains the methods in use in the arid States in the distribution and use of water in irrigation. It gives a large number of measurements made to determine the duty of water and the losses by seepage and evaporation from canals, and discusses the methods by which the water supply may be more effectively and economically utilized in the production of crops.

Irrigation in New Jersey, by Edward B. Voorhees, director, New Jersey Agricultural Experiment Stations and professor of agriculture, Rutgers College (Bulletin No. 87, pp. 40, figs. 5), gives the results of a number of experiments on different kinds of small fruits, melons, and vegetables during 1898 and 1899, made for the purpose of determining whether irrigation during short periods of drought in regions where the rainfall is usually sufficient for the maximum growth of crops will sufficiently increase the yield to pay for the works necessary to obtain the supply of water, and reports observations on the construction and cost of six small irrigation plants in New Jersey.

Irrigation in Hawaii, by Walter Maxwell, director and chief chemist, Hawaiian Experiment Station (Bulletin No. 90, pp. 48, pls. 6, figs. 3), discusses the climatic soil and other conditions as affecting irrigation in Hawaii, and gives the results of irrigation experiments, especially with sugar cane, carried on by the author for a number of years.

The Reservoir System of the Cache la Poudre Valley, by E. S. Nettleton (Bulletin No. 92, pp. 48, pls. 14), contains a description of the reservoir system of the Cache la Poudre Valley, showing the benefits to be derived from the construction of reservoirs for the storage of water for irrigation.

Irrigation Laws of the Northwest Territories of Canada and Wyoming, with discussions by J. S. Dennis, deputy commissioner of public works, Canada, and Fred Bond, State engineer of Wyoming, and J. M. Wilson, agent and expert, irrigation investigations, Office of Experiment Stations (Bulletin No. 96, pp. 90, pls. 5), includes texts of the irrigation laws of the northwest territories of Canada and of Wyoming, with the regulations, forms, and methods of procedure adopted in the administration of these laws, and discussion of the principles underlying the laws and the methods followed in their enforcement.

Irrigation Investigations in California, by Elwood Mead and others (Senate Doc. No. 108, Fifty-sixth Congress, 2d session, pp. 73). This

is an abridged preliminary report on investigations reported in full in Bulletin No. 100, noted below, prepared in response to a Senate resolution.

Practical Irrigation (Yearbook of the Department of Agriculture, 1900, pp. 491-512, figs. 9), by C. T. Johnston and J. D. Stannard, gives simple directions for the use of the individual farmer.

There were also prepared and submitted for publication the following:

Report on Irrigation Investigations in California, under the supervision of Elwood Mead, assisted by Wm. E. Smythe, Marsden Manson, J. M. Wilson, Chas. D. Marx, Frank Soulé, C. E. Grunsky, Edward M. Boggs, and James D. Schuyler (Bulletin No. 100, pp. 411, pls. 29, figs. 16), which gives an account of investigations conducted in California during 1900 by this Office, cooperating with the California Water and Forest Association, which consisted of observations by irrigation experts on the existing legal, engineering, and agricultural conditions along nine typical streams used for irrigation in the State.

Irrigation in Field and Garden, by E. J. Wickson (Farmers' Bulletin No. 138, pp. 40, figs. 18). For note on this bulletin see page 200.

EXTENSION OF INVESTIGATIONS.

In response to numerous requests from those engaged in irrigation in the Hawaiian Islands, plans are being made for a bulletin dealing with the irrigation laws and customs which now control the ownership and distribution of streams in those islands. The immense sums of money already invested in pumping plants and irrigation works required for the irrigation of sugar cane gives to this subject an importance commensurate with the magnitude of these investments and with the value and scarcity of the water supply on which success depends. It is manifest that the same problems which have arisen in California and other arid States where streams have been fully utilized will have to be dealt with in these islands, and it is the belief of those most directly concerned that this investigation can greatly promote the enactment of needed and salutary laws by an early study of the subject and publication of the facts disclosing existing conditions and requirements.

The utilization of underground water is becoming each season more important, and it is destined to assume a general interest should irrigation be largely extended to the humid region. Requests for assistance in determining whether or not pumping water for irrigation will pay and the conditions which govern its profitable application are being constantly received, but thus far but little has been done in this direction, although a beginning has been made during the present season. It is one of the lines of work which can be usefully and profitably extended.

In all of the older irrigated countries irrigation and drainage have gone hand in hand, and the experience of the arid States is that we are not to be any exception to this rule. The building of high-land canals and the application of water to the farm beneath them sooner or later tends to create an excess of moisture in the lower lands. The percolating waters from the upper canals, or from the irrigated fields, carry with them an excess of alkaline salts which tends to accumulate in the bottom lands and thus render them worthless. As these salts are all readily soluble, drainage is the readiest and most certain means of removing both the excess of moisture and the excess of alkali, but

effective drainage is not a matter which the individual farmer can always provide. In many of the irrigated districts of the West the areas needing drainage are so extensive that these works, whether for removing the water already in the soil or cutting off supplies from the canals and fields above, must be carried out under a comprehensive plan, which in some cases involved not only farms and communities, but an entire valley.

This Office has been solicited to study this question, and a beginning has been made in this direction. From the nature of the problem, these improvements should be under public direction. In order to properly assist in the formation of plans for drainage of irrigation districts and the framing of laws to govern the organization of community or district improvements, this study should embrace the experience of the States of the Middle West, where drainage is already an important feature of agriculture and is carried out under State laws as a public improvement. The publication of a bulletin dealing with the operation of State drainage laws and the results which have attended their operation will greatly aid in the framing of laws required for the removal of the surplus waters of many Western irrigated districts. This investigation should also include the cost of manufacture and kind of materials required, because the salts contained in much of the water to be removed will destroy the tiling used elsewhere. Thus far the price of tiling has been so excessive as to be almost prohibitive. That this can be changed by the erection of factories within some districts to be benefited is certain. The investigation should show the feasibility of such factories, the places where the material for the manufacture of tiling can be obtained, and the approximate cost of such manufacture. At the present time clay tiling is the cheapest material in some sections, cement in others, and plank in others. The farmers of the West desire to know which they can employ to the best advantage.

Studies of the methods of irrigation, the duty of water, and the results of seepage and evaporation will be continued as before, the effort being made to encourage the agricultural experiment stations to take up the more scientific and detailed studies of the duty of water and leave to this Department only those larger problems of stream management which have a direct influence on the success of irrigation laws and the efficiency of public supervision in the distribution of the water supply. A number of the Western experiment stations are already paying increasing attention to this, the Montana, Utah, Colorado, and Arizona stations being especially conspicuous in this work.

The growing volume and immense cost of litigation over water rights and the certainty that these complications are destined to continue unless the operation of our irrigation codes is made simpler and more effective, renders it increasingly important that we avail ourselves of the experience of older irrigated countries. The lessons of southern Europe and Egypt should be made use of through visits to these districts, and the publication of reports showing the methods employed in the distribution of water, the methods of its application, and the volume required; the kinds of contracts under which water is furnished to users; the nature of the ownership of streams and of the canals which distribute them. The beginning of these studies has been unavoidably delayed, but their necessity and the value of the information to those engaged in framing codes of laws, or in enforcing those laws, is believed in more earnestly than when the same subject was referred to in the previous report of this Office. It is hoped that a beginning may be made in this work during the present year.

THE GROWING IMPORTANCE OF IRRIGATION.

It is becoming more and more apparent that irrigation is destined to have a larger place in the agriculture of the humid portion of the United States than a few years ago was thought possible. It is already employed as a means of insurance wherever intensive cultivation is resorted to. Market gardeners in New Jersey, in the vicinity of Boston, and around nearly all the large cities of this country are coming more and more to understand the security and profit which it brings. The rapid extension of rice irrigation in the South promises to influence the utilization of water in the growing of other products in that region wherever a supply can be obtained at a reasonable cost. The development of the arid region by irrigation is destined in the near future to cease to be a matter of local interest, and to occupy a leading place in National affairs. This is due to the fact that the vacant fertile lands of the inland States have now been taken up. We must look elsewhere to meet the demands of development, and it is the irrigated lands of the arid region which must replace the farms rendered unproductive by erosion and impoverished by wasteful and exhaustive methods of culture. To meet the growing home demand and to satisfy our expanding foreign trade will tax not only the utmost resources of the humid States, but the productive resources of the arid region as well. On the solution of the problems now being studied in this investigation must rest the laws which will govern the ultimate development of the large areas of public land yet awaiting settlement and reclamation. Its work is as important to the nation in aiding it to determine what it ought to do as in assisting the arid States in solving the problems which press for an immediate solution.

The fact must not be lost sight of that in the arid region agricultural values inhere in water rather than in land. In many sections of the West the right to water which irrigates an acre of land is already worth far more than the land itself, and the methods by which titles to streams are acquired and the character of the ownership established has as direct a relation to the development of the West as the methods employed in the disposal of public land. It is just as necessary, too, for the peace and prosperity of that region to keep streams from being acquired by speculative owners as it is to keep the land from being disposed of to speculative holders. In some cases extravagant and unjust grants of water have led to serious abuses, and it is only through a general education of the people most concerned that the expulsion of these abuses and the establishment of correct methods can be secured. The great work of this investigation is to promote the evolution of irrigation laws and customs suited to the needs of the different sections of the arid region and necessary for the protection of the individual farmer. As irrigation has extended and streams become more fully utilized it has become increasingly apparent that water laws are fully as important as land laws, and that it is not only necessary to define clearly the rights of each of the multitude of users from a common supply, but to provide adequately for the protection of these rights under some sort of public supervision, so that the peaceful and orderly division of rivers among farmers shall not only be possible but assured. It is also indispensable that there shall be men especially trained for this work. Under the most favorable conditions the harmonious division of a river is a complex and difficult performance. It involves the regulation of rights on tributaries so as to protect the rights on the main stream and a consideration of the

needs of the farmer whose land lies scores or even hundreds of miles away from the snows which must moisten it in order that he may not be robbed by the farmer whose ditch or canal taps the water supply at the mountain's base. It involves the adjustment of diverse and conflicting interests of individuals, communities, and sometimes of different States. Because the whole subject is new, development has outgrown organization. We have built ditches and dried up streams faster than we have evolved laws and customs for the protection of the users of their waters. The beginning of this investigation was the beginning of a disinterested and scientific study of these questions. The value of these labors is now becoming manifest in all of the different States of the arid region. It has stimulated the movement for better laws and in many cases has resulted in a reform in methods that has increased yields and extended the area cultivated. With these changes there has come a demand for information and advice wholly beyond our means to supply. It now is confronted by two needs—increased means for more comprehensive study of facts, and a larger force of trained and capable men to assume the important responsibility of directing the gathering of these facts and the interpretation of their significance when secured.

For continuing and extending the irrigation investigations an estimate of \$75,000 was made a year ago. With the progress of our work during the year the demands for its extension from various quarters have increased and the opportunities for the useful employment of a larger fund have widened. I therefore recommend that this amount be asked for in the estimates for the ensuing fiscal year.

REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROAD INQUIRIES.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF PUBLIC ROAD INQUIRIES,
Washington, D. C., August 31, 1901.

SIR: I have the honor to submit herewith the report of the Office of Public Road Inquiries for the fiscal year ended June 30, 1901, together with an outline of the work for the current year and recommendations and estimates for the ensuing year.

Respectfully,

MARTIN DODGE,
Director.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

The work of this Office during the fiscal year 1901 was continued and extended along the lines laid down in my previous reports and in pursuance of the general plans and purposes of the inquiry. The correspondence of the Office has steadily increased during the year and the office force has been busily engaged distributing large quantities of literature to farmers, road builders, and other interested persons. Representatives of the Office visited nearly all the States and made scientific investigations regarding local conditions, road materials, etc. The information secured is being prepared for publication, and will be of much practical benefit to the interested localities. Several State legislatures have asked for and received assistance in framing new road laws. Farmers' organizations, farmers' institutes, business organizations, schools, colleges, etc., have also petitioned for our cooperation and advice and all of them have been accommodated as far as our resources permitted.

The progress of road construction has been closely watched, and it is very gratifying to note that never before in the history of this country has there been so much interest taken in the subject, and so much actual road work done as in the past year. More requests have been made for the expert advice and supervision of this Office than ever before. Every effort has been made to meet these demands, but this has been possible only to a limited extent, owing to the present small force and limited resources of the Office. This practical side of our work has been pushed forward as rapidly as the time and means at hand would permit. The object-lesson methods of teaching practical road building, adopted and carried forward by the Office for several years, have become so valuable and are so highly appreciated that there is an urgent and widespread demand for their continuation, and many calls are being made for their extension.

PRESENT ORGANIZATION.

The Office as now organized has an administrative office consisting of a Director, an assistant director, one special agent and expert, a stenographer, a clerk, and a messenger.

The road-material laboratory is operated in collaboration with the Bureau of Chemistry, and Mr. L. W. Page is in charge with three permanent assistants and one temporary assistant.

REPORTS ON FIELD WORK.

As indicated in my last report, the United States has now been divided into four divisions, known as the Eastern, Southern, Middle, and Western, with a special agent and expert in charge of each.

EASTERN DIVISION.

Mr. L. W. Page, the special agent in charge of the Eastern division, having been placed at the head of the road-material laboratory, has been engaged during the greater part of the year in work connected with the testing of road materials, and the field work of this division is therefore not reported upon.

SOUTHERN DIVISION.

Prof. J. A. Holmes, of North Carolina, was appointed special agent of the Southern division on August 7, 1900. During the year Professor Holmes has visited portions of nearly all the States of his division, examining into the character and distribution of materials suitable for road building. In many of the localities visited he has collected samples of material, which have been forwarded to the Washington testing laboratory, and the results of these investigations have been reported directly to the State, county, or municipal authorities especially interested in the matter. Special reports embracing the results of these investigations will be submitted at an early date.

While the chief purpose in Professor Holmes's travels through the Southern States has been the examination of the road-building material, he has endeavored at the same time, as an object of scarcely less importance, to encourage and organize the good roads movement in the several States in every way possible. With this object in view he has visited the county and State authorities, and in many cases has advised with them as to the best plans for promoting this movement. He has also given public lectures on road building at the State universities of North Carolina, Georgia, Alabama, and Louisiana, and at various towns in the different States; he has also appeared before legislative committees in the interest of good-road laws in the States of North Carolina, South Carolina, Georgia, Tennessee, and Virginia. On all these occasions he has advised (1) the establishment of State highway commissions; (2) the abandonment of the old system of compulsory road labor, and the substitution therefor of a system of road building and repairing roads by taxation; (3) the use of convict labor in road building. These are important features of any system that may be adopted for the improvement of the public highways. I am glad to be able to record the fact that in each of these Southern States this view of the situation is being generally accepted, and will doubtless be acted upon as rapidly as practicable. During the year

advanced legislative measures for making better roads have been adopted in both the Carolinas, Georgia, Tennessee, Arkansas, and Texas, and it is safe to predict that similar action will be taken in other Southern States at the next sessions of their respective legislatures. During the year Professor Holmes has endeavored to collect accurate information concerning the status of the road movement in every county of the States named, and he has thus far brought together such information from more than 1,000 out of a total of about 1,200 counties. The results of these inquiries are being tabulated and will appear in a bulletin to be submitted for publication at an early date. The reports indicate decided progress in both road legislation and practice in many portions of these States. Professor Holmes is also bringing together in a systematic record the names and addresses of a number of the most progressive citizens living in each of the counties of the division, and through these persons it is hoped that, by means of correspondence and by the distribution of printed matter, much can be done in the way of stimulating and guiding the good-roads movement.

In addition to a paper on "The use and results of convict labor in road building," for the Yearbook for 1901, the special agent for this division has now in preparation and will soon submit for publication reports on "Some types of road building in the Southern States" and "The present status of the good-roads movement in the Southern States."

MIDDLE DIVISION.

In September, 1900, Hon. J. H. Stout, of Menomonie, Wis., was appointed special agent for the Middle division, and Expert Charles T. Harrison was sent to him as assistant. Owing to the lateness of the season, no outside work was engaged in other than that done at Traverse City, Mich., to be referred to later on in this report. Soon after entering upon his work a visit was paid to the county fair at Kewaunee, Wis., where consultations were held on the matter of road improvement and an address was delivered. A farmers' institute at Knapp, Wis., was also attended for the same purpose.

During the winter months the educational feature of the work was taken up, and visits were made to the agricultural college at St. Anthony Park, Minn., where several addresses were made to special classes as well as to the students. Frequent conferences were held with county and State school officials relative to arranging for a series of illustrated addresses on road construction in the public schools, and this plan will very likely be carried out in the near future. Many requests were made for aid and information throughout the Middle division, but on account of the unseasonable weather and the lack of sufficient funds but little beyond the giving of written or printed information could be done.

About the middle of April, Road Expert Harrison was called from this division and assigned to the National Good Roads Association's train, which he accompanied on its tour of nearly 4,000 miles, during which time he acted as consulting engineer, and delivered addresses at several points where sample roads were built and conventions held.

ILLINOIS WORK.

During the months of September and October Mr. Howard H. Gross, of Chicago, was employed as special agent and expert for the purpose

of collecting and disseminating information in the State of Illinois. He cooperated with the officials of the State in building a sample road upon the State fair grounds at Springfield. He also delivered three addresses there upon the general subject of good roads.

Mr. Gross distributed among the farmers and business men of the State over 200,000 circulars of information. He visited, by invitation, 35 county and Congressional farmers' institutes and delivered addresses on "The relation of good roads to farm life," "How to build good roads and the cost thereof," and "Good roads viewed from the farmer's standpoint."

He made a special feature of State-aid legislation, and 31 out of the 35 institutes visited passed resolutions strongly indorsing such legislation as would provide for the equitable distribution between the State, counties, and townships of the cost of permanent roads. At the request of the legislative committee of the State Farmers' Institute, held at Winchester, Ill., on October 30, Mr. Gross prepared and presented to the legislature a bill that was known as the "Curtis bill."

The result of this work in Illinois aroused a deep and widespread interest in the subject of good roads, and this matter is now a leading topic of discussion by the press throughout the entire State. Public sentiment in Illinois in favor of better roads is rapidly crystallizing.

WESTERN DIVISION.

Mr. James W. Abbott, of Denver, Colo., was appointed special agent and road expert August 18, 1900, to take charge of the Rocky Mountain and Pacific Coast division. During his thirty years' service as a civil and mining engineer, Mr. Abbott has had much practical experience with the problems of road location and construction, but in order that he might be able to do the best work as a special agent he gave up his mining work, and has since devoted himself exclusively to the study of the road question and to practical work for the betterment of the highways in the large territory assigned to him.

He has had extensive correspondence with the various road commissions of the several States and of the Dominion of Canada, the directors of agricultural experiment stations, and many others. He has, by personal interviews and private letters, brought the subject of road improvement to the attention of governors and other State officials, the editors of leading newspapers, professors in institutions of learning, presidents and managers of railroads, prominent civil and mining engineers, members of the legislatures, boards of county commissioners, road supervisors, the heads of leading industries, manufacturers of road machinery, besides a large number of influential private citizens.

He attended and participated in the work of four very important conventions, at two of which he read papers. He has written several articles for publication in leading newspapers, and numerous interviews have been published giving accounts of his movements and work. He spent some time in consultation with the road committees of the Colorado legislature and assisted in framing a carefully prepared road law. He visited many places in Colorado, Utah, and California, and gave advice where it was desired regarding specific or general road improvement. Mr. Abbott visited, practically at his own expense, this Office and the highway departments of New York, Massachusetts, and California. In all he has traveled during the year over 12,000 miles.

Mr. Abbott wrote a paper on "Mountain roads" for the last Year-book of this Department, which has since been republished in pamphlet form for general distribution. It was a technical article, giving detailed information regarding practice in mountain-road construction. The paper has been quite extensively republished in the press of different parts of the United States.

PRACTICAL ROAD WORK.

Requests for the practical cooperation and assistance of this Office in actual road building and in addressing meetings have been more numerous this year than ever before. Owing to our limited means, however, but few of these requests could be complied with. In this work the Office has endeavored to assist those sections of the country which needed help most, and to work in those States and communities where little or nothing had yet been done by us. The Office has also cooperated to the fullest extent possible in the construction of various kinds of roads and in the dissemination of information at road conventions and other meetings in the following States: Michigan, Alabama, Pennsylvania, Kansas, Illinois, Tennessee, Louisiana, Mississippi, Kentucky, North Carolina, South Carolina, Wisconsin, Minnesota, Iowa, Ohio, New York, Delaware, Maryland, Virginia, Georgia, Arkansas, Texas, Colorado, Montana, Wyoming, Nebraska, Utah, and California. Object-lesson roads have been built under the direction of the Office in the first nine of these States, while the results of our investigations and practical assistance in road meetings have been extended to all the others. From five to twenty-five addresses were delivered by representatives of the Office in each of these States. Brief reports of the most important work done in some of the States are given:

MICHIGAN.

A review of the work done during the early part of the fiscal year 1901 at Port Huron was given in my last report. Experts from this Office also assisted in building sample roads during road conventions at Saginaw and Traverse City. A brief statement of the work done at Traverse City will serve to illustrate the methods pursued by the agents of this Office at both these places. It may be given in the words of the special agent in charge, whose letter to the Office is as follows:

MENOMONIE, WIS., *October 30, 1900.*

DEAR SIR: As soon as possible after receipt of your request, I started for Traverse City, Mich. On arrival I found that the machinery for the sample stone road had not been assembled. By energetic work everything was in readiness by Tuesday noon, October 9. The work of crushing and placing the stone was pushed, so that on the first day of the convention there was a section of macadam foundation laid and rolled in readiness to receive the final surfacing of stone, a portion of which was spread and rolled during the convention.

The convention proper met in business session Thursday morning, October 11, when the address of welcome was made by Mayor A. V. Fredericks, to which I responded in your behalf. The balance of the session was devoted to reports and speeches from delegates from the thirteen counties represented.

In the afternoon the machinery, donated for the work by the Port Huron Engine and Thresher Company, was paraded through the streets of the city to the scene of the operations, the traction engine hauling a train of 10 heavy wagons loaded with delegates and other interested people. Addresses were made on the ground by Hon. Frank Hamilton, Thomas T. Bates, and myself, my address being on the lines of practical road construction, forcibly illustrated by the work in progress. A largely attended meeting held in the evening in the opera house was addressed by Hon. A. E. Palmer, of Kalkaska, and Special Agent H. S. Earle, of Detroit.

Friday, October 12, the road machinery was paraded to the Peninsula road, where an exhibition of spreading and rolling gravel was made. In the afternoon a trip was made to Garfield Township, where a fine object-lesson road was shown, illustrating the value of drainage in reclaiming swamp lands and the construction of a gravel road thereon. Brief addresses were made and questions answered by Hon. A. E. Palmer and myself.

At the request of the committee in charge I remained a week longer to assist in the completion of the work. When I left, October 18, there were about 800 feet of foundation placed and 325 feet of finished surface. The road had an average width of 10 feet and a depth of 8 inches of macadam made from crushed field stone of a good quality. Gravel shoulders were placed on each side of the stone construction. The cost of the work was approximately as follows: Drainage of the swamp lands, \$300; graveling Peninsula road, \$400; graveling about one-fourth of a mile of macadam road, \$500. Incidental expenses in finishing the road brought the total cost of all the work done up to \$1,500 or about \$2,000 per mile.

Respectfully,

CHARLES T. HARRISON,
Special Agent and Road Expert.

Subsequent reports from Michigan show that after passing through a very severe winter the drainage of the Traverse City road has proved successful. The gravel road is still hard, smooth, and free from ruts, and the macadam first-class in every respect. As a result of this work Traverse City and vicinity are making rapid strides toward better streets and roads. The aid extended by the Office in this matter was greatly appreciated by the city and county authorities, and as a result efforts are being made for the holding of road conventions and the construction of sample roads at Cheboygan and Ludington during the present season. It will be impossible, however, for the Office to do more for Michigan this year, as engagements have already been made which will keep our present force busy for several months.

ALABAMA.

There is, perhaps, no other section of the country better supplied with good road material than the northern portion of Alabama. Immense deposits of the most excellent quality of chert are found in that State along the banks of the Tennessee River. This material, on account of the large percentage of silica, which gives it a good wearing quality, and of iron, which enables it to readily consolidate and form an impervious mass, makes one of the most desirable and valuable road materials found anywhere in the country. The people of Florence, Ala., appreciate the value of this material, but the county road officials, realizing their inability to apply it to the best advantage, made an application to the Department to assist them in building a short section of road out of their local materials. Mr. Eldridge, assistant director of the Office, was sent there during the month of August, 1900, to investigate and experiment with this material, and the result seems to have been highly satisfactory. Previous to this experiment, the county authorities had been using "creek gravel" in preference to the chert, owing to the fact that the gravel could be secured with little or no effort, while the chert had to be laboriously dug from the bank. Mr. Eldridge built a section of road with the pure chert and a section composed of creek gravel as a foundation and chert as a surface. The roadbeds were well drained, graded, shaped, and rolled, and the materials were spread and rolled in two courses, each 4 inches in thickness. The material was blasted out with dynamite and powder. It was found by experiment and a study of existing roads that the chert was much more satisfactory than the gravel previously used, but that such gravel could be used, provided

it be surfaced with enough chert to hold it in place and to prevent its washing into the side ditches.

Chert roads can be built in northern Alabama at from \$200 to \$500 per mile, and we believe, if the work is properly done, that they will last for many years with but little repair, and that their surface will be as smooth and hard as that of the best stone and gravel roads. The success of this work is shown by the following extract from the Florence Times:

The Times, in connection with the public-spirited citizens of Lauderdale County, wishes to tender grateful thanks to Mr. M. O. Eldridge, the assistant director of the Office of Public Road Inquiries, for the valuable lesson in road building which he recently gave to our people. We hope it will prove, as it should be, the forerunner of economical and practical road building in our county.

PENNSYLVANIA.

At the close of the last fiscal year, work on an object-lesson road at Doylestown, Pa., was still being carried on, but was not completed until early in the fall. This work, brief mention of which was made in the last report, was about one-half mile in length, one-eighth of a mile being 8 feet wide, the balance 12 feet wide, with earth shoulders sloping to wide open ditches. The old earth road was considered one of the worst pieces of public road in that section, having an exceedingly sharp grade, with a miry strip at the foot of the hill caused by the lack of proper facilities for carrying off the water. Considerable cutting and filling was done and the grade was reduced to an average of 3 per cent. Native stone of a good quality was used. On part of this road a telford foundation, 6 inches deep, was laid; the surface was composed of native trap rock, machine broken, laid to a depth of 3 inches and dressed with screenings. Another portion of the work was of macadam construction, with a depth of 6 inches, laid on a hard natural foundation. Considerable difficulty was experienced in hauling water, getting teams for the roller, etc., but in spite of these obstacles, a good road has been secured, which stood last winter's freezes and thaws surprisingly well. The cost of the work was \$1,520.50, and a bid has been submitted to finish the road to Doylestown Borough for \$1,100, which would make the cost of a mile of road \$2,620.50.

At the National Farm School the experimental work, conducted by Expert Charles T. Harrison, resulted in road construction being added to the school curriculum, and the building of a good earth road 1,200 feet long by 20 feet wide in April last by the students under the direction of Prof. W. T. Pope, horticulturist. This road leads from the object-lesson road to the school building, and is known as "Memorial lane."

At the request of Congressman Acheson and other prominent citizens of Washington County, Pa., the Office secured the loan of a complete road-building outfit and supervised the building of about a mile of object-lesson road in North Strabane Township of that county. Hard-road material in that part of the State is very scarce, but the county authorities were fortunate in securing enough limestone of good quality to build this road, and, when our machinery and experts arrived, this material had been piled up along the road ready to be crushed. The machinery consisted of a rock crusher, elevator, screen and bins, road machine, and road roller. It was loaned to the Department by the Champion Road Machine Company, and was transported from Kennett Square to Canonsburg, Pa., by the courtesy of the Pennsylvania Railroad Company.

The sections of road selected for these experiments are located near the old McMillan Church and radiate from the church in four different directions, about a quarter of a mile of macadam road being constructed on each of these radiating roads. A West Virginia brick-making establishment presented the township with a carload of paving brick, which was also used in making an experimental piece of brick road on the section leading from the McMillan Church toward Canonsburg.

Under a new law, permitting the employment of convicts on the public roads of Pennsylvania, about a dozen prisoners from the county jail were used in quarrying the stone and in building this experimental piece of road. The use of convicts proved entirely satisfactory, and it seems probable that Washington and adjacent counties will in the future utilize misdemeanor convicts in similar work.

Washington County is very hilly and some grading had to be done. After this was completed the foundations were well drained, prepared, and rolled in the usual manner, and the stone was applied in three separate layers, each layer being rolled until smooth and compact. The width of the material was about 10 feet and the depth when rolled about 6 inches. Wide earth shoulders were prepared on each side sloping uniformly to the side ditches in such a way as to allow vehicles to pass. After a sufficient amount of road had been built, a "road day" was arranged for, and the farmers from every section of that and adjacent counties were invited. This demonstration was planned for the purpose of spreading knowledge of road making among the farmers and county road officials. The meeting was well attended, about 500 farmers being present, and the work seemed to arouse the entire countryside.

The following letter from Congressman Acheson shows his appreciation of the work done in Washington County by this Office:

WASHINGTON, D. C., *February 1, 1901.*

SIR: Inclosed find letter of ex-Sheriff W. C. Ramsey, of Washington County, Pa., in reference to the cooperation of your Department in the construction of a sample road in South Franklin Township of that county. In this connection, I wish to say that the experiment made in Washington County last fall under the direction of Mr. Eldridge awakened a deep interest among the farmers, and has done a great deal to promote the cause of good roads. I should like to see the appropriation increased, so that you could undertake such experiments in every county in the country.

Yours, truly,

ERNEST F. ACHESON, M. C.

KANSAS.

A very successful State good-roads convention was held at Topeka, Kans., September 25-28, 1900. The citizens of Shawnee County raised the necessary funds to build $1\frac{1}{2}$ miles of macadamized road, a section of which was constructed under the supervision of Mr. E. G. Harrison, of this Office. The rock for this work was shipped in already crushed, being a by-product from one of the mines near Topeka. The construction of the road was carried on during the convention, thus serving as an object lesson. Mr. Harrison and the Director were on the ground during the progress of the work in order to explain the details of practical and theoretical road building to the delegates. Two carloads of machinery for this work were loaned by the Port Huron Engine and Thresher Company, and were carried to Topeka by the railroads without cost to this Office.

The objects of this convention were to awaken and promote a general interest in the improvement of the public roads of Kansas, and

to discuss the various ways and means of securing the necessary funds for this purpose, as well as the best methods for constructing and maintaining good roads. I believe that these objects were fully attained.

WORK OF THE "GOOD-ROADS TRAIN."

During the months of April, May, June, July, and August, 1901, this Office cooperated with the National Good Roads Association of Chicago in the operation of a "good-roads train" through the Mississippi Valley from New Orleans to Chicago. The Illinois Central Railroad furnished the train, including 9 cars for machinery, 1 car for laborers, and 1 combination dining and sleeping car for road experts and officials and the press representatives. The railroad company also provisioned the train and furnished part of the skilled and common labor. The machinery was loaned by the manufacturers, who also supplied experts to operate the same.

The Director accompanied the train on its initial trip from Chicago to New Orleans and through a portion of Mississippi, delivering addresses at several conventions. Leaving the train at Jackson, Miss., the assistant director of the Office joined it there and represented the Office during the remainder of the trip. Road Expert Charles T. Harrison, of this Office, accompanied the expedition, but, being at this time on furlough without pay, his expenses, together with compensation for his services, were paid by the National association.

The "good-roads train" visited the following places, where sample roads, varying in length from a half mile to $1\frac{1}{2}$ miles, were built and where the officers of the National association organized permanent local and State associations: Flossmoor, Ill.; New Orleans, La.; Natchez, Vicksburg, Greenville, Clarksdale, Oxford, Granada, MeComb City, and Jackson, Miss.; Jackson, Tenn.; Louisville, Hopkinsville, and Owensboro, Ky.; Cairo and Effingham, Ill.

About 20 miles of earth, stone, and gravel roads were built and 15 large and enthusiastic conventions were held. The numbers attending these conventions and witnessing the work were very large, in nearly every instance more than a thousand persons and in some cases 2,000 persons being present. Among the attendants were leading citizens and officials, including governors, mayors, Congressmen, members of legislatures, judges of the county court, and road officials. This was undoubtedly the most successful campaign ever waged for good roads, and the expedition has been of great service to the cause, and especially to the people of the Mississippi Valley.

TESTING OF ROAD MATERIALS.

The importance of laboratory tests on road materials has long been recognized both in this country and in Europe. For over thirty years the national schools of roads and bridges of France have conducted careful tests of all materials used in the construction of National highways. These laboratory tests have been the means of greatly reducing the cost of road construction, and it is a well-known fact that the French roads are the best in the world. Since 1893 a number of laboratories for testing road materials have been in operation in this country, and their aid to road builders in obtaining good and economical results has been thoroughly demonstrated.

In December last we established a road-material laboratory, which occupies comfortable quarters in the building of the Bureau of

Chemistry. This laboratory is now in full operation, and any citizen of the United States interested in the construction of public highways can have road materials tested free of charge.

The methods employed in this laboratory are very practical and in many respects original, and the work done has proved most satisfactory. The general methods employed are briefly as follows:

When an application to have a sample tested is received at the laboratory, a blank form is sent to the applicant to be filled out with necessary information regarding it. The sample is then subjected to an abrasion test to determine its resistance to wear; a cementing test for determining its cementing or binding power; a toughness test; and a hardness test. Other information regarding the sample is also secured and furnished to the applicant, such as its density, absorptiveness, and proper nomenclature.

When expert advice is asked as to the suitability of two or more samples for a particular road, a blank form for making a fourteen-day census of the volume and character of traffic over that particular road is sent to the applicant to be filled. When this information is received at the laboratory a request is made to the Weather Bureau to supply a record of the meteorological conditions obtaining in the particular locality through which the road passes. From a study of these combined data the expert in charge of the laboratory is able to make a thoroughly scientific selection of the material best suited for the particular road. This method of selection eliminates, as far as possible, any personal error, and makes what has been heretofore a very complicated problem one of simple engineering.

Up to the present time about 100 samples of rock have been received and tested at the laboratory, and applications for tests are being received in steadily increasing numbers. Most of the machinery and appliances had to be especially built for the laboratory. These were designed by Mr. L. W. Page, who is in charge.

URGENT DEMANDS FOR OFFICE ASSISTANCE.

The state of public opinion regarding the work of this Office, the character of the demands made upon it, and the pressing need for an extension of the work can best be shown by a few brief quotations from the thousands of letters, newspaper clippings, and copies of resolutions on file in the Office.

FROM CORRESPONDENTS.

Mr. James W. Thompson, a prominent gentleman of Louisville, Ky., in acknowledging a copy of our last Yearbook article, says:

I wish to thank you, the Department, and the Hon. Martin Dodge for the help you have given us in Kentucky on the good-roads question, as without it we could not have accomplished what we have.

I hope Congress will make a more liberal appropriation for the maintenance of your Office, which I think is one of the most important connected with the Government. What you have accomplished with the small appropriation you have is something wonderful.

Mr. Arthur T. Neale, director of farmers' institutes for Delaware, writes:

The managers of the farmers' institute would like to give much time to meetings devoted to the road question this winter. * * * May I ask whether lecturers can be secured for institute work from among those holding positions under you?

The Director is almost daily in receipt of requests similar to the following, which was made by a correspondent from Florida. He urges the Director to attend the annual convention of the Good-Roads Association of Florida, and adds:

I believe that an efficient stereopticon lecture, giving a bird's-eye view of the most important public roads of the world, would not only be instructive, but would give a new impetus to good roads throughout this State. I most respectfully request you to send such a lecturer to be with us the nights of the 20th and 21st of February next in Jacksonville for the benefit of the members of our convention and the public generally.

Senator Shoup, of Idaho, refers a letter to this Office, indorsed as follows: "With the earnest recommendation that the Department lend such assistance as is possible to the citizens in the vicinity of Genesee, Idaho, in improving the roads in that locality." The Senator's correspondent writes as follows:

The roads in southern Latah County are much the worst in the State and the roads in the vicinity of Genesee are worse than in any other part of this county. Our people are stirred up over the matter and propose to do something to better the roads, and would like the assistance of the Government Road Division. If you can help us to secure the advice and assistance of the Road Bureau you will confer a favor on the entire community and place us under great obligations to you.

The Citizens' Association of Ludington, Mich., makes the following petition:

We are now about to spend a large sum on macadam road work. We stand in need of some instruction; not only the council, but citizens generally need to understand the subject. It is new here. Can Mr. Harrison, or some other expert, come here; if so, at what expense to us? The sooner the better, of course, as we are now at work.

Congressman Pearre, of Cumberland, Md., writes:

I was talking to you some time ago about building a sample road in Allegany County, Md. Will you be able shortly to construct a half-mile sample road in Allegany County for me? I have authority from the county commissioners to proceed with the matter, with the understanding that they will pay such share of the expenses as is usual in such cases. I am anxious to have this done as soon as possible.

Captain Shaw, of the United States Navy, in a letter on file in this Office, says:

Realizing the great advantage to the cause of good roads from the construction of sample roads under the direction of the Road Inquiries Office, I respectfully suggest that such a road be built from Charlottesville, Va., to Monticello, the grave of Jefferson, a distance of about 2 miles.

This location is peculiarly adapted to the purpose, first, because that grave is visited yearly by a great number of people from every part of the country, making a road thereto a National rather than a local object lesson; and, second, because Charlottesville is an educational center for the South, having some 700 students from its various States.

The number of persons visiting such a road would naturally be largely increased by the fact that Charlottesville is the point of junction of the two great railroad systems—the Southern and the Chesapeake and Ohio.

If, in view of the foregoing, it should be decided to build such a road, I respectfully request information as to what aid would be given by the Department in regard to inspection of material, technical supervision, etc.

The following letter has been received from Marshalltown, Iowa.

I understand you are doing some experimental road work in the different States. If this is the case, we are very desirous to have you aid us with one of your experiments. We are much in need of a better system of roads leading out of Marshalltown into the country. We have ideal experimental ground, taking in many different phases of road work in a very short distance, such as drainage, bottom lowland, and hill work.

Will you kindly advise me what you are doing along this line, and can you aid us along your lines of work?

An eminent correspondent from the State of Oregon writes:

I am not opposed to a reasonable effort on the part of the Government in advancing scientific explorations of every kind, but this is one of more importance than many others. It involves the question of cheap and rapid transportation of the products of the farm to market. * * *

I hope that your appropriation will be increased and that your Department will urge the matter before Congress. This subject is of more importance than improvements of rivers and harbors or armies and navies, however important they may be.

The following communication from the Tama, Iowa, Business Men's Association, addressed to the Secretary of Agriculture, will be of interest:

We have noticed with a great deal of satisfaction the interest displayed by your Department in the pressing question of improved public highways, and desire to be permitted on behalf of the organization which we represent to convey by this our appreciation of the efforts being put forth by you in the "good roads" movement.

Right immediately south of our city lies the Iowa River bottom, one of the garden spots of the State, but to cross which with a load of farm products during the rainy seasons is nearly impossible. There were weeks during the early part of the past winter when it was almost impossible for the farmers to get to or from the city of Tama from the south even with empty vehicles.

There is but one public highway leading south from this city, and about 3 miles of this lies across the river bottom, with its "mucky" black soil, which for road purposes is much like a thick composition of South Carolina pitch.

A movement has just been started by the Tama Business Men's Association looking to the proper draining, tiling, and graveling of this 3 miles of public highway. The work must needs be done by popular subscription, and your experience will remind you that the task of raising funds for its prosecution is no small one.

Knowing your interest in the movement for the betterment of our highways, and understanding as we do that you have under the direction of your Department competent and expert talent, we very respectfully and earnestly ask if you can not see some way to send us some help. A practical road engineer who could make the surveys, profiles, estimates, etc., working under your Department would be a boon which would be held in grateful remembrance by a host of Tama County citizens.

FROM THE PRESS.

Hundreds of earnest editorials and articles have been written during the past year setting forth the value and importance of the work of this Office, many of these urging its extension and some of them insisting upon a larger appropriation. It would be impossible, in this report, to copy even the most important clippings, but on account of the deep interest felt in the matter, a few extracts to illustrate the sentiment of the press generally are appended:

[From the American, Baltimore, Md.]

It is proposed to appropriate hundreds of millions of dollars for a canal across the isthmus to accommodate the commerce of the world. If Congress can be so generous toward the world's commerce, it surely ought to be willing to make a small appropriation for domestic commerce, all of which is between American citizens. To build what is intended to be a great artery of commerce, and leave the veins which are to feed it in a more or less congested condition, seems to be the reverse of good statesmanship. Education is what the public needs in the matter of good roads. It must be shown that it costs little more to build and maintain them than bad ones, and that the good roads put vastly more money into the pockets of the taxpayers than they take out of them. Congress, if it will, can teach this lesson without seriously impairing the balance in the Treasury.

[From the Journal, Boston, Mass.]

The General Government can not embark upon the work of actual road construction on a large scale, but it can promote and systematize this work when

undertaken by States and smaller communities, and it can accumulate information which will prevent the waste of money and effort. The Department of Agriculture, already of great use to the agricultural interests, will extend the value of its service by this new enterprise.

[From the Herald, St. Joseph, Mo.]

The good roads congress does not ask the Government to build good roads for the country, but it does ask that the Department of Agriculture be given an appropriation with which to build sample roads and spread information about them among the people. It recognizes the fact that road building is the business of the people themselves, and thinks that they will not put up with poor roads longer than it takes them to learn the advantages of good ones.

[From the Journal, Elizabeth, N. J.]

The Government, through the Agricultural Department, with a small appropriation, has already built a number of sample roads—very short ones—and the instruction thus given has been of great value, and has proven an incentive to the building of many miles of good roads. A larger appropriation would doubtless prove proportionately beneficial. There are many sections of the country which do not yet appreciate good roads, and do not know how to build them, and Government instruction with object lessons in those sections can hardly fail of good results. Moreover, good roads help the Government in the way of establishing rural free deliveries.

[From the Chronicle, Marion, Ind.]

Congress may pass a ship subsidy law; the rivers and harbors may receive appropriations; Federal buildings may appear in many small cities; but in all this, we, of Indiana, are not directly interested. The prime thing with the people of this State is good roads. The greater number of the citizens of the State are vitally interested in local transportation facilities.

It is suggested that Congress appropriate for the Department of Agriculture a sum for the building in every State of one sample of good country road. It is remembered that while \$14,000 was set aside by Congress for the Road Inquiry Bureau last year, \$20,000,000 were appropriated two years ago for rivers and harbors; and this may be doubled soon. In these the people of the inland country have no direct interests. The people of Indiana do not contend that there should be no expenditure on rivers and harbors, but they have come to the conclusion that the roads of the country, being close to the home, being the first thing of vital importance in a community, should have a larger degree of consideration at the hands of the promoters of public good.

[From the Mercury, San Jose, Cal.]

It is not proposed that the General Government shall begin the work of road construction, but that it shall simply encourage it by making available the scientific knowledge of the Department of Agriculture in a practical way. This is certainly a worthy purpose. The improvement of our highways means as much for the welfare of the country, particularly of the producers, as does the improvement of the waterways and railroads. It is an important work of education which the Department of Agriculture is well fitted to undertake and carry on to the best advantage.

[From the Times-Star, Cincinnati, Ohio.]

It was also decided to ask the United States Congress to keep up its support of the Office of Public Roads, under the control of the Department of Agriculture. Excellent results having already been achieved through this Office, which devotes itself in the main to the diffusion of knowledge respecting the practical method of constructing good roads and to answering such questions as may be asked about road building generally. It is conceded that great good has resulted already from the agitation of this matter, and that the roads of the United States as a whole are to-day in vastly better condition than they were only a few years ago.

[From the Capital, Sedalia, Mo.]

The Road Inquiry Bureau has been very helpful to the cause of better public highways during the past few years. It has gathered useful statistics and experimental information, and it has had a representation at nearly every conspicuous good roads convention held since the Bureau was established. It has distributed a great deal of good roads literature, and has been of real assistance to the move-

ment which has given several of the States greatly improved systems of public highways. Congress should by all means make liberal appropriations for this branch of the Agricultural Department's service.

RESOLUTIONS.

The National Good Roads Association, at its last annual meeting in Chicago, where delegates had assembled from 35 States of the Union, passed the following resolution:

Resolved, That we earnestly recommend that our Representatives in Congress be urged to obtain, if possible, an appropriation of at least \$150,000 a year to be applied to the uses of the Public Road Inquiries under the Department of Agriculture in extending its work of education and instruction.

The State Grange of Delaware passed the following resolutions at its last annual session:

Whereas the more permanent and economical building of public roads is a question of vital importance to the farming community, and whereas the methods of construction and maintenance of such roads must vary with the nature of the country and of that of the available material; therefore

Be it resolved, First, That the organization of a National Good Roads Bureau under the United States Department of Agriculture has our hearty support.

Second, That the plan of that Bureau to furnish the engineering skill and certain pieces of heavy machinery necessary in construction of model roads in every State of this Union meets with our approval.

Third, That the section of the bill of the United States Department of Agriculture now before Congress, which provides for an increased appropriation with which to pay the expenses of such model road building, also meets with our approval, and we hereby direct our secretary to at once send a copy of these resolutions to our Senators and Representatives in Congress with the request that they give to this matter their active support.

Several large conventions, some of them comprising 2,000 people, have been held throughout the Central and Southern States under the auspices of the National Good Roads Association during the past year, and nearly all of these conventions adopted resolutions in favor of the work of this Office and its further extension. A few of these resolutions are presented.

The Louisiana State Good Roads Association, in convention assembled at New Orleans, adopted the following:

Resolved, That we heartily approve the work of the Office of Public Road Inquiries, and urge our Senators and Representatives in Congress to vote for suitable appropriations for carrying on and extending the same.

The Mississippi Good Roads Association, at Greenville, passed the following resolution:

Whereas the United States Government has large interests of commercial value in this State in the form of lands, post offices, and custom houses; and whereas through the Department the Government is expending large sums of money in the extension of rural free delivery in order that the agricultural classes may possess better mail facilities; and whereas rural free mail delivery to be economical must depend upon good roads: Therefore be it

Resolved, That the Good Roads Convention, through Hon. Patrick Henry and other Members of Congress, urge the Fifty-seventh Congress to make more liberal appropriations for the support and maintenance of the Office of Public Road Inquiries, now under the supervision of the honorable Secretary of Agriculture, in order that all States may receive reasonable consideration for road improvement.

The Tennessee Good Roads Association, at Jackson, passed the following resolution:

Be it resolved, That we earnestly request that the National Government continue the appropriations to the Office of Public Road Inquiries, and that this convention heartily appreciate and indorse the good work which it is doing.

The Western Kentucky Good Roads Convention, at Hopkinsville, passed the following:

We urge and recommend the members of Congress from western Kentucky to use their influence to secure sufficient appropriation for the Office of Public Road Inquiries under the Department of Agriculture of the United States Government.

We believe that the burden of common-road improvement must be shared by the taxpayers of each State, but we further believe and declare that the Federal Government should establish a sufficient bureau for the proper education of the people in the most economic and scientific methods of road construction in the several States.

The Kentucky Good Roads Association, in convention assembled at Louisville, passed the following resolutions, which are similar to those adopted by the convention which assembled at Owensboro, Ky.:

Resolved, That we earnestly recommend the Members of Congress from Kentucky to urge larger appropriations in the Fifty-seventh Congress for the support of the Office of Public Road Inquiries under the Department of Agriculture, in order that said Office may extend its education by distributing bulletins and constructing sample roads as object-lessons in all States and Territories. The Government owns lands, post offices, and custom houses in all States. It is deeply interested in extending rural mail facilities to promote the social and commercial advancement of the agricultural classes. We believe that the burdens of common-road improvement must be shared by the taxpayers of each State; but we further believe, and be it

Resolved, That the Federal Government should aid, through the Office of Public Road Inquiries, in educating the people in the most economic and scientific methods of road construction in the several States.

DEATH OF SPECIAL AGENT HARRISON.

The good-roads movement has sustained a severe loss during the year in the death of the veteran road builder, Mr. E. G. Harrison, who died in this city February 6, 1901, at the age of 73.

Mr. Harrison was one of the pioneer road builders of New Jersey, and the success of the movement in that State was largely due to his untiring zeal and conscientious work. For several years he had been connected with this Office as special agent and road expert, and during this time he directed the construction of object-lesson roads and demonstrated the importance of road improvement in nearly every State east of the Rocky Mountains. His presentations of facts and theories were unique and effective, and he was universally liked. His work for American highways was in many respects similar to that of John L. Macadam, the pioneer road builder of England.

PLANS FOR 1901-1902.

It is intended during the ensuing year to continue the work and enlarge its scope so far as the appropriation will admit. We have made only a small beginning in the work designed to be done throughout the country, and there are now on file numerous applications for our assistance. We have already had to forego numerous opportunities to take charge of the construction of sample roads where practically all the expense except that of our supervision was guaranteed. Under such conditions a minimum appropriation by the General Government can be used to accomplish a maximum of good results.

Out of a large number of requests for practical cooperation, five places have been selected where this Office will assist in building

object-lesson roads. These places are Buffalo, N. Y.; Cumberland, Md.; Charlottesville, Va.; Jonesboro, Tenn., and Tama, Iowa. In the work at Buffalo we will cooperate with the National Good Roads Association in building sections of the various kinds of roads, including earth, gravel, macadam, tar macadam, brick, etc. We will also assist in the International Good Roads Congress, which is to be held in Buffalo September 16-21, 1901.

The money has already been raised and the preliminary arrangements made for the building of about a mile of macadam road near Cumberland, Md., and we expect to go forward with that work as soon as the Buffalo meeting has adjourned.

Preliminary surveys and estimates have been made for the construction of an object-lesson road from Charlottesville, Va., to the old home and tomb of Thomas Jefferson, and prominent citizens of Virginia have asked the assistance of this Office in the construction of this road, which is to be called the "Jefferson Memorial Road." As soon as the grading is completed an expert will be sent there to direct the construction of a model macadam road, and when a sufficient section has been finished, the Director of the Office will go there to attend a State good-roads convention, which will be composed of representatives from all parts of the State.

It was decided by Congress at its last session to build a National soldiers' home near Jonesboro, in East Tennessee, and several prominent citizens of Jonesboro, including Congressman W. P. Brownlow, have requested us to send an expert there to direct the construction of a first-class macadam road from Jonesboro to the new soldiers' home. If our funds hold out this request will be complied with.

Last March, by your direction, Expert Charles T. Harrison was sent to Tama, Iowa, to consult with prominent citizens and road officials as to the best methods of improving the roads in the Iowa River bottoms near Tama. Mr. Harrison reports that the roads, although in their worst condition, were just right for inspection. He also says that material for the proper surfacing of these roads can not be easily secured, but by applying modern methods of drainage, the dirt highways can be vastly improved. The citizens of Tama have requested us to direct the construction of a short section of road as an object-lesson and to cooperate with them in holding a good-roads convention. If sufficient funds can be raised at Tama for the building of a half mile or so of road, the request will be complied with.

Prominent citizens of Marshalltown, Iowa, are also desirous of having a short section of a road improved under our directions, and it may be possible to do some work there also while the Tama work is in progress.

The National Good Roads Association contemplates the making up of another "good-roads train" to be operated in the Southern States during the coming winter, and, if arrangements are completed for this project, this Office should cooperate to the extent of furnishing a road engineer to direct the construction of object-lesson roads and to deliver practical addresses at the road conventions.

The Office will also endeavor to comply with as many as possible of the requests which are now on hand, and which are constantly being received, to assist in farmers' institutes and other meetings during the coming winter and spring. Many of these requests are referred to our division agents, but a majority of them have to be met by the office force.

RECOMMENDATIONS AND ESTIMATES FOR 1902-1903.

It is proper just here to call attention to a misconception which appears to exist in the minds of some to the effect that increased appropriations for this work may lead to National aid. It should be distinctly understood that the work of this Office, like that of many other Divisions of the Department, is purely educational. In requesting an increased appropriation it was not the intention to shift the burden and responsibility of constructing improved roads from the States and counties to the General Government. Such a plan is not feasible, and even if it were, it would not be desirable, for there could be no surer way of postponing the building of good roads than by making them dependent upon National aid. Under such a system States and counties would wait for National aid and little or nothing would be done.

In order to meet the constantly increasing demands that are being made upon us from time to time for practical assistance and advice, it would be advisable to organize two or three outfits of road-building machinery, including rock crushers, screens, rollers, road graders, etc., and to send them to the various places which have asked for the cooperation of the Department, and where preparations have been made for actual road construction. Each of these outfits should be accompanied by one or two practical road builders and a competent road engineer to direct the work.

Heretofore this Office has been aided generously by the loan of road-making machinery, but the time has now come to abandon this make-shift policy and for the Government to purchase its own equipment for object-lesson work. This item of expense would not be a large part of the total sum needed and recommended. The leading railroads are deeply interested in the improvement of the public highways and have heretofore carried all our machinery free of charge, and it is thought that they can be relied upon in the future to carry it at a comparatively small expense to the Government.

If an appropriation is made by Congress for carrying out this plan, the only expense to the Department will be the salaries and traveling expenses of the engineers and expert road builders, the cost of the machinery, and the freight on the same from point to point. The local authorities would cheerfully furnish the road materials, which could be selected by our divisional agents and tested in our laboratory. They would also contribute the common labor, teams, and fuel, and attend to the grading down of hills, if that should be required.

This plan has been operated to a limited extent by the Office for several years, and during the months of April, May, June, and July almost the same project was carried on by the National Good Roads Association in cooperation with this Office. It is but proper to state here that this object-lesson work could not have been entered into by the Office but for the National association, which paid the expenses, including the salary of our own engineer and a portion of the traveling expenses of the Director and assistant.

The general adoption of this method of experimenting and disseminating practical information establishes a very wide cooperation, comprising the Department, the railroads, the various local road authorities, the agricultural colleges and experiment stations, and interested individuals. It makes the expense of building experimental and sample roads very easy to be borne, and would enable the

Government with a small expenditure to accomplish much practical benefit.

Scientific road building necessitates not only the consideration of local conditions, such as climate and soil, rainfall and drainage, but also a study of available materials adjacent to the road. To transport materials a great distance adds so much to the cost as to render roads scientifically constructed of foreign materials impracticable. Competent road builders should discover and test the available materials and show by practical object-lessons how the most good can be made of them with the least possible expenditure of money and labor. The best materials are not always discovered, and thousands of dollars are wasted in this country annually by the use of poor materials where a little expert study and advice would have developed good materials close at hand. The best methods of using these materials are oftentimes unknown, and money is wasted in their improper application. All these things require scientific study and investigation. The people of the country are now interested in this matter as never before, and they are demanding and are sorely in need of authentic information along these lines. Furthermore, this is a work which the Government can do for them much better and more economically than they can do for themselves.

After having considered all letters, requests, and resolutions which have come to the Department, and after consulting and corresponding with many of the most prominent farmers and road advocates throughout the country, I have the honor to recommend that Congress be asked to increase the appropriation for this Office for the next fiscal year to \$75,000. If this increase is granted, I would recommend that there be devoted, provisionally, to investigations and educational work \$1,000 in each of the States and Territories, and that the balance be used in defraying the running expenses of this Office and the road-material laboratory.

The necessity of furthering the work of this laboratory is felt all over the country, and at least \$10,000 is needed for carrying on this branch of the work for the next fiscal year. The small sum of \$1,500 heretofore allotted to each of the four divisions of the country is not sufficient to pay the salary and expenses of competent persons. The Department should be able to command the entire time and attention of those representatives, but in order to do this at least \$2,500 should be set apart for each division.

Our small force has been so completely occupied with outside work that the preparation of didactic literature had to be neglected. This branch of the work should also receive more attention, especially the collection, illustration, printing, and distribution of practical and scientific information. I trust, therefore, that you will find it within your power to secure at least \$75,000 for the use of this Office for the next fiscal year.

When the last report was submitted there was some doubt as to whether we could secure a sufficient number of trained men to carry on extensive investigations in the various States, but during the past year the Office has devoted a great deal of attention and study to the selection of persons who are sufficiently skilled to inaugurate this work. It is gratifying to announce that we are now prepared to greatly extend the work of this Office, and the appropriation above mentioned, if granted by Congress, will be expended judiciously and wisely.

REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ACCOUNTS AND DISBURSEMENTS,
Washington, D. C., August 1, 1901.

SIR: I have the honor to submit herewith a brief report of the work of this Division for the year ended June 30, 1901.

Respectfully,

F. L. EVANS,
Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

APPROPRIATIONS, EXPENDITURES, ETC.

The total amount appropriated by Congress for the several lines of work of the U. S. Department of Agriculture for the fiscal year ended June 30, 1901, was \$3,303,500, an increase of \$558,920 over the amount appropriated for the preceding year. The total payments from this sum will be, when all accounts shall have been finally settled, about \$3,220,000.

Fifteen thousand dollars each for the 48 agricultural experiment stations in the several States was also appropriated.

The supplemental accounts for the years 1899 and 1900, paid during the year, amounted to \$255,689.40.

The unexpended balances of the appropriations for the year 1899, amounting to \$28,899.27, were covered into the Treasury on June 30, 1901.

During the year 20,677 accounts were received, audited, and paid, as follows: Divisional, 7,124, amounting to \$1,219,287; Bureau of Animal Industry, 4,374, amounting to \$957,900.42; Weather Bureau, 9,179, amounting to \$1,060,139.30; making a total of \$3,237,326.72. In payment of these accounts 30,379 checks were drawn on the Treasury at Washington and subtreasuries at New York and Chicago. The number of checks in excess of the number of vouchers is explained by the fact that many of the latter were salary rolls containing from 5 to 100 names each. Only four checks were lost in the mail.

The amount expended for telegraphing and telephoning for the Weather Bureau, including the West Indian cable service, was \$183,837.05.

A further extension of the telephone system in the Department at Washington, exclusive of the Weather Bureau, was made during the year. The system now includes 40 regular and 5 auxiliary telephones, and covers practically all the branches of the Department. In addition to this main system, the Bureau of Animal Industry has a special internal system of 16 telephones connecting its several offices and laboratories.

REQUISITIONS, LETTERS, REQUESTS, CONTRACTS, AND LEASES.

To meet the regular expenditures of the Department 107 requisitions were drawn on the Treasury against the various appropriations, amounting to \$3,278,702.12.

The number of requisitions for supplies was 6,416.

The number of letters of authority for travel was 2,445.

The number of letters written and received in the regular transaction of business was 34,871.

The number of requests issued for passenger transportation was 2,490.

The number of requests on the Quartermaster-General for transportation of Government property was 2,124.

The number of leases executed and in effect was 135.

The number of contracts for supplies, etc., was 170.

PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from all sources and deposited in the Treasury to the credit of the proper funds the following sums:

Sale of condemned property	\$2,481.32
Sale of Card Index	163.76
Sale of publications, Weather Bureau	174.44
Seacoast telegraph line receipts, Weather Bureau	1,728.49
Sale of American products in Europe	514.96
Total	5,062.97

APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES.

The following table shows the appropriations, disbursements, and unexpended balances for the year ended June 30, 1901:

Appropriations, disbursements, and amount unexpended for the fiscal year 1901.

Object.	Appropriations, 1901.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks	\$326,680.00	\$319,677.35	\$7,002.65
Library	5,000.00	2,641.41	2,358.59
Contingent expenses	37,000.00	34,238.54	2,761.46
Animal quarantine stations	50,000.00	39,736.30	10,263.70
Collecting agricultural statistics	110,000.00	103,090.81	6,909.19
Botanical investigations and experiments	30,000.00	27,198.58	2,801.42
Entomological investigations	22,500.00	21,217.94	1,282.06
Vegetable pathological investigations	28,000.00	26,309.57	1,690.43
Biological investigations	17,500.00	16,082.79	1,417.21
Pomological investigations	9,500.00	8,861.36	638.64
Laboratory	28,500.00	26,835.45	1,664.55
Forestry investigations	80,000.00	75,685.49	4,314.51
Experimental gardens and grounds	20,000.00	19,814.43	185.57
Soil investigations	25,000.00	24,690.44	309.56
Grass and forage-plant investigations	17,000.00	13,712.78	3,287.22
Irrigation investigations	50,000.00	41,411.71	8,588.29
Agricultural experiment stations [\$780,000] ¹	60,000.00	53,789.87	6,210.13
Nutrition investigations	17,500.00	14,850.15	2,649.85
Arlington experimental farm	10,000.00	9,878.14	121.86
Public-road inquiries	14,000.00	12,619.69	1,380.31
Publications	105,000.00	104,140.26	859.74
Purchase and distribution of valuable seeds	170,000.00	137,753.69	32,246.31
Investigating production of domestic sugar	7,000.00	5,830.73	1,169.27
Tea-culture investigations	5,000.00	4,959.42	40.58
Salaries and expenses, Bureau of Animal Industry	1,000,000.00	877,661.06	122,338.94
Total	2,245,180.00	2,022,687.96	222,492.04
WEATHER BUREAU.			
Salaries	153,320.00	152,688.11	631.89
Fuel, lights, and repairs	9,000.00	8,318.80	681.20
Contingent expenses	8,000.00	7,139.45	860.55
General expenses	828,000.00	387,981.59	518.41
Meteorological observation stations	60,000.00	328,578.91	110,921.09
		55,978.86	4,021.14
Total, Weather Bureau	1,058,320.00	940,685.72	117,634.28
Grand total	3,303,500.00	2,963,373.68	340,126.32

¹ Of this amount, \$720,000 was paid directly to the experiment stations from the Treasury Department.

ACCOUNTS FOR THE FISCAL YEAR 1899 FINALLY CLOSED.

The accounts for the year ended June 30, 1899, were finally closed on June 30, 1901, and the balances of the various appropriations carried to the surplus fund and turned into the Treasury, on that date, as follows:

Amount of unexpended balances turned into the Treasury.

Object.	Appropriations for 1899.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks	\$319,300.00	\$315,986.70	\$3,313.30
Furniture, cases, and repairs	9,000.00	8,667.75	332.25
Library	6,000.00	5,659.51	340.49
Museum	1,500.00	1,465.36	34.64
Postage	2,000.00	2,000.00	-----
Contingent expenses	25,000.00	23,888.08	1,111.92
Animal quarantine stations	12,000.00	11,833.38	166.62
Collecting agricultural statistics	105,000.00	100,952.48	4,047.52
Botanical investigations and experiments	20,000.00	19,972.07	27.93
Entomological investigations	20,000.00	19,812.64	187.36
Vegetable pathological investigations	20,000.00	19,634.32	365.68
Biological investigations	17,500.00	17,373.26	126.74
Pomological investigations	9,500.00	8,248.18	1,251.82
Laboratory	12,400.00	12,028.15	371.85
Forestry investigations	20,000.00	19,520.52	469.48
Experimental gardens and grounds	20,000.00	19,879.66	120.34
Soil investigations	10,000.00	9,885.85	114.15
Grass and forage-plant investigations	10,000.00	9,950.99	49.01
Irrigation information	10,000.00	9,997.49	2.51
Agricultural experiment stations [\$760,000] ¹	40,000.00	39,536.38	463.62
Nutrition investigations	15,000.00	14,903.08	96.92
Public-road inquiries	8,000.00	7,469.50	530.50
Publications	65,000.00	64,773.62	226.38
Purchase and distribution of valuable seeds	130,000.00	128,350.61	1,649.39
Investigating production of domestic sugar	7,000.00	6,860.30	139.70
Salaries and expenses, Bureau of Animal Industry	900,000.00	7920,164.47	6,828.45
Total	1,814,200.00	1,818,824.35	22,368.57
WEATHER BUREAU.			
Salaries	153,340.00	152,597.83	742.17
Fuel, lights, and repairs	8,000.00	7,822.31	177.69
Contingent expenses	8,000.00	7,755.87	244.13
General expenses:			
Salaries	765,162.00	380,950.03	1,244.97
Miscellaneous		380,535.62	2,431.38
Meteorological observation stations	75,000.00	73,316.42	1,683.58
Erection of building at Sault Ste. Marie, Mich.	3,000.00	2,994.12	5.88
Repairs to buildings and grounds, Bismarck, N. Dak.	3,000.00	2,999.10	.90
Total, Weather Bureau	1,015,502.00	1,008,971.30	6,530.70
Grand total	2,829,702.00	2,827,795.65	28,899.27

¹ Of this amount \$720,000 was paid directly to the experiment stations from the Treasury Department.

² Includes \$26,992.92 received from sale of American products in Europe.

MONTHLY CHECK STATEMENT, SETTLEMENT OF ACCOUNTS, ETC.

The monthly check statements from the Treasury and subtreasuries were received and found to agree with the books of this office. All vouchers were forwarded quarterly to the Treasury, passed upon by the accounting officers, and certified as correct. The annual report to Congress of all expenditures of the Department for the year 1900 was prepared in this office and submitted through the Speaker of the House of Representatives.

ANNUAL SUPPLIES.

Bids for annual supplies were solicited in May in the usual manner, and contracts were made covering nearly all the lines of supplies needed by the Department during the ensuing year at prices varying but slightly from those of the preceding year. All contracts were secured by satisfactory bonds.

CONTRACT FOR SEEDS.

A contract for seeds for Congressional distribution, on account of the \$170,000 appropriated for the "Purchase and distribution of valuable seeds, 1901," was awarded to the lowest bidder, The New York Market Gardeners' Association, A. C. Nellis, manager, in the gross sum of \$68,874.12, with the privilege of \$40,000 additional at prices fixed by said contract.

ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1902, were prepared in this office according to the usual practice, and were submitted to Congress through the Secretary of the Treasury, accompanied by an explanation of all changes from the appropriations of the preceding year. The estimates for 1902, including \$720,000 for agricultural experiment stations, carried an increase over the appropriations for 1901 of \$444,050, and amounted in the aggregate to \$4,467,550. The estimates included an item for \$200,000 for new laboratory buildings. No appropriation, however, was made for these buildings.

For 1902, Congress appropriated \$114,870 more than was estimated for by the Department, as shown in the following table. Of this sum, \$100,000 was for seeds for Congressional distribution.

Appropriations and estimates for 1902.

Object.	Amount appropriated for 1902.	Amount estimated for 1902.
Salaries, officers and clerks.....	\$373,820.00	\$334,230.00
Library.....	7,000.00	7,000.00
Contingent expenses.....	37,000.00	37,000.00
Animal quarantine stations.....	25,000.00	25,000.00
Collecting agricultural statistics.....	120,000.00	135,000.00
Botanical investigations and experiments.....	45,000.00	35,000.00
Entomological investigations.....	25,500.00	25,000.00
Vegetable pathological investigations.....	60,000.00	50,000.00
Biological investigations.....	20,000.00	27,500.00
Pomological investigations.....	20,000.00	19,500.00
Laboratory.....	24,500.00	33,500.00
Forestry investigations.....	146,280.00	180,000.00
Experimental gardens and grounds.....	20,000.00	25,000.00
Soil investigations.....	91,000.00	105,000.00
Grass and forage-plant investigations.....	20,000.00	17,000.00
Irrigation investigations.....	50,000.00	75,000.00
Agricultural experiment stations [\$789,000] ¹	69,000.00	81,000.00
Nutrition investigations.....	20,000.00	20,000.00
Arlington experimental farm.....	10,000.00	10,000.00
Plans for building.....	5,000.00	.....
Public-road inquiries.....	20,000.00	20,000.00
Publications, including Farmers' Bulletins.....	173,000.00	107,500.00
Purchase and distribution of valuable seeds.....	270,000.00	170,000.00
Investigating production of domestic sugar.....	5,000.00	7,000.00
Tea-culture investigations.....	7,000.00	5,000.00
Bureau of Animal Industry.....	1,050,000.00	1,100,000.00
Total.....	2,714,100.00	2,651,230.00
WEATHER BUREAU.		
Salaries.....	159,820.00	155,320.00
Fuel, lights, and repairs.....	9,000.00	9,000.00
Contingent expenses.....	8,000.00	8,000.00
General expenses.....	865,500.00	858,000.00
Meteorological observation stations.....	60,000.00	60,000.00
Buildings.....	46,000.00	6,000.00
Total, Weather Bureau.....	1,148,320.00	1,096,320.00
Grand total.....	3,862,420.00	3,747,550.00

¹ Of this amount \$720,000 is paid directly to the experiment stations from the Treasury Department.

APPROPRIATIONS FOR 1901 AND 1902.

The appropriations for 1901 and 1902 appear in the following table, and it will be seen that there is an increase in favor of the latter year of \$558,920:

Appropriations for the years 1901 and 1902.

Object.	Amount appropriated for 1901.	Amount appropriated for 1902.
Salaries, officers and clerks.....	\$326,680.00	\$373,820.00
Library.....	5,000.00	7,000.00
Contingent expenses.....	37,000.00	37,000.00
Animal quarantine stations.....	50,600.00	25,000.00
Collecting agricultural statistics.....	110,000.00	120,000.00
Botanical investigations and experiments.....	30,000.00	45,000.00
Entomological investigations.....	22,500.00	25,500.00
Vegetable pathological investigations.....	28,000.00	60,000.00
Biological investigations.....	17,500.00	20,000.00
Pomological investigations.....	9,500.00	20,000.00
Laboratory.....	28,500.00	24,500.00
Forestry investigations.....	80,000.00	146,280.00
Experimental gardens and grounds.....	20,000.00	20,000.00
Soil investigations.....	25,000.00	91,000.00
Plans for administrative building.....		5,000.00
Grass and forage-plant investigations.....	17,000.00	20,000.00
Irrigation investigations.....	50,000.00	50,000.00
Agricultural experiment stations [\$780,000] ¹	60,000.00	60,000.00
Nutrition investigations.....	17,500.00	20,000.00
Arlington experimental farm.....	10,000.00	10,000.00
Public-road inquiries.....	14,000.00	20,000.00
Publications, Farmers' Bulletins.....	105,000.00	173,000.00
Purchase and distribution of valuable seeds.....	170,000.00	270,000.00
Investigating production of domestic sugar.....	7,000.00	5,000.00
Tea culture investigations.....	5,000.00	7,000.00
Salaries and expenses, Bureau of Animal Industry.....	1,000,000.00	1,050,000.00
Total.....	2,245,180.00	2,714,100.00
WEATHER BUREAU.		
Salaries.....	153,320.00	159,820.00
Fuel, lights, and repairs.....	9,000.00	9,000.00
Contingent expenses.....	8,000.00	8,000.00
General expenses.....	828,000.00	865,500.00
New buildings at stations.....		46,000.00
Meteorological observation stations.....	60,000.00	60,000.00
Total, Weather Bureau.....	1,058,320.00	1,148,320.00
Grand total.....	3,303,500.00	3,862,420.00

¹The total appropriations under this head are \$730,000 and \$780,000 for the years given, respectively, but \$720,000 of each appropriation is paid directly to the experiment stations from the Treasury Department. The sums included in the figure columns represent only the amount available for departmental expenditures.

NEW BUREAUS.

Four new bureaus were created by the appropriation act for the year 1902 by raising to that grade certain scientific Divisions of the Department, as follows:

Bureau of Plant Industry, which includes what were formerly the Divisions of Vegetable Physiology and Pathology, Botany, Pomology, Agrostology, and Experimental Gardens and Grounds.

Bureau of Forestry, which is to include forestry work in the United States.

Bureau of Soils, for the investigation of soil problems, including the mapping of tobacco soils.

Bureau of Chemistry, for the investigation of food adulteration, food preservatives, etc.

The several amounts appropriated for these Bureaus are divided as follows:

Appropriations for the new Bureaus.

Bureau.	Salaries.	General expenses.	Total.
Bureau of Plant Industry	\$39,680	\$165,000	\$204,680
Bureau of Forestry	39,160	146,280	185,440
Bureau of Soils	18,140	91,000	109,140
Bureau of Chemistry	11,300	24,500	35,800

A salary of \$3,000 each is provided for the chiefs of these Bureaus, with assistants at \$2,500 each. The question of salaries for the scientific corps of the Department of Agriculture has been a matter of consideration by the Committee on Agriculture for several years past.

NEW BUILDINGS AT WEATHER BUREAU STATIONS.

The Weather Bureau appropriations were increased by \$90,000 for 1902 for the purpose of establishing new stations, erecting new buildings where needed, a new cable to Tatoosh Island, State of Washington, for the circulation of daily weather reports by the newly established rural free-delivery routes, and for the installation and operation of a system of wireless communication between the mainland and Tatoosh Island. Of this sum, \$26,000 is intended for the purchase of a site and the erection of a small brick and wood building at each of the following-named places, for the use of the Weather Bureau, and for all necessary labor, materials, and expenses, plans and specifications, and for the purchase of instruments, furniture, supplies, storm-warning towers, etc., to properly equip the same:

Appropriations for new Weather Bureau stations.

Atlantic City, N. J.	\$6,000
Hatteras, N. C.	5,000
Fort Canby, Wash.	4,000
Port Crescent, Wash.	3,000
Tatoosh Island, Wash.	5,000
Point Reyes, Cal.	3,000
Total	26,000

PLANS FOR NEW ADMINISTRATIVE BUILDING.

The sum of \$5,000 is appropriated "to enable the Secretary of Agriculture to have prepared, under his direction, plans for a fireproof administrative building, to be erected on the grounds of the Department of Agriculture, in the city of Washington, said plans, and such recommendations thereon as the Secretary of Agriculture may deem necessary, to be transmitted to Congress at its next regular session." This is the first decided and substantial step in the direction of a new administrative building, and is the result of persistent and determined efforts by the Department for many years past. The Committees on Agriculture and on Appropriations are favorably disposed toward an appropriation for this purpose, fully realizing its importance, and a very friendly feeling exists among Members of Congress generally, the necessity for a new building being well understood.

RENT OF ADDITIONAL BUILDINGS.

Two thousand dollars is provided for the payment of rent for the ensuing year for the Bureau of Forestry, the accommodations in the main building being wholly inadequate to the needs of the Bureau. In this connection all of the seventh floor and part of the eighth floor of the Atlantic Building, 908 F street NW., was leased on July 1, 1901, at an annual rental of \$2,000, and the Bureau force has been installed therein, together with all office fixtures and furniture.

The appropriation for the Division of Publications carries \$2,500 "for the rent of a building and for such alterations as may be needed, for the storage of publications." The Department has arranged with the owner of ground on B street, between Thirteenth and Thirteen-and-a-half streets SW., who is now erecting a large, double brick building, which is to be completed at an early date, and will be leased by the Department for a period of years, subject to an annual appropriation by Congress for rental. The building will be arranged expressly to accommodate the work of the Division of Publications in the storing and handling of publications.

These sums added to the amounts paid for other private property already under lease will make for rental in the District of Columbia, for the year ending June 30, 1902, over \$10,000.

LAW CLERK.

In the estimates for this Department for the fiscal year ended June 30, 1897, one "law clerk" was provided for at an annual salary of \$2,200. The recommendation failed to receive the approval of Congress, and no further effort has been made in that direction. Since then, however, on account of the urgent necessity for legal advice, a third-class clerk on the roll of the Secretary has been detailed to act as law clerk, and assigned to duty in the Division of Accounts and Disbursements. Although not a regular graduate, this clerk has a fair knowledge of law, especially departmental, and has performed the duties of the trying position very acceptably.

The legal work of the Department has increased enormously during the past two or three years, while the importance and serious character of the questions involved require the most careful and expert consideration. The amount and importance of the work will continue to increase with the growth and development of the Department; in fact the work has already grown to such proportions that the services of an assistant law clerk could be utilized not only to advantage, but will shortly become an actual necessity. This is the only Department of the Government without a statutory roll for legal experts, and it is earnestly recommended that a law clerk be included in the estimates of this Department for the next fiscal year.

REVISED EDITION OF THE FISCAL REGULATIONS.

A revised edition of the "Fiscal regulations of the Department" was issued on July 1, 1901. This edition includes all amendments made necessary by recent rulings of the Comptroller of the Treasury; it also includes certain modifications of the rules of the Department governing field expenses, etc. Among other changes \$5 is allowed for daily subsistence instead of \$4, as formerly. Laundry expenses are also allowed when the travel extends beyond one week.

REPEAL OF ACT PROHIBITING ADDITIONAL COMPENSATION.

The act approved March 3, 1885, relating to additional compensation to employees of the Department of Agriculture, has a very important bearing upon the work of the Department, and it is thought proper to include in this report a letter from the Secretary of Agriculture on the subject, to the chairman of the Senate Committee on Agriculture and Forestry, as this letter fully explains the situation as affected by the act. The repeal of this section was approved by the House Committee on Agriculture and the Senate Committee on Agriculture and Forestry at the last session of Congress. The repealing clause, as recommended in the Secretary's letter to Senator Proctor, had the expressed approval and support of both committees, and appeared as an amendment to the Senate bill, but for some reason the amendment was stricken from the bill in the committee on conference. It is hoped that the objectionable section may be unconditionally repealed at the next session of Congress. The letter is as follows:

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 17, 1901.

Hon. REDFIELD PROCTOR,

Chairman Committee on Agriculture and Forestry, United States Senate.

SIR: In making the appropriation for this Department for the fiscal year 1886 (act approved March 3, 1885, 23 Statutes at Large, 353-356). Congress saw proper to enact a section worded as follows:

"SEC. 2. That no part of the money herein or hereafter appropriated for the Department of Agriculture shall be paid to any person, as additional salary or compensation, receiving at the same time other compensation as an officer or employee of the Government; and in addition to the proper vouchers and accounts for the sums appropriated for the said Department, to be furnished to the accounting officers of the Treasury, the Commissioner of Agriculture shall at the commencement of such regular session present to Congress a detailed statement of the expenditure of all appropriations for said Department for the last preceding fiscal year."

The effect of this enactment was to impose upon this Department restrictions and duties from which other Departments have remained free. I am advised that the foregoing restriction upon the use of the appropriations for this Department was imposed because a former official had somehow managed to receive compensation from the Government from three different sources. The restriction was not then, and has not been since, imposed upon the other Executive Departments, presumably because Congress is not aware of any necessity for such legislation.

The singling out of this one Department (which was at that time a much less important establishment than it is at present) and the maintenance of this distinction down to this time may justly be looked upon as a reflection upon the official management of the business of the Department of Agriculture. The distinction should be obliterated, either by imposing it upon other Departments, or by relieving this Department from the necessity of observing it. The public interests do not appear to require it. Other Departments do not suffer from lack of the protection it was supposed to afford. On the other hand, it does most seriously militate against the interests of this Department by prohibiting the employment of technical experts who happen to be connected with other branches of the Government for special service in this Department. It renders it impossible for this Department to utilize, even in the smallest way, the service of many of the ablest specialists in the country. It inflicts a heavy burden upon the Disbursing Officer, who is thus compelled to maintain a constant watch over the entire public service; and in spite of the utmost care, it is not always possible for him to avoid actual losses. Indeed, it would seem to impose upon him the necessity of being always provided with the names of all the employees of the Government, not only in Washington, but elsewhere throughout the country, and his list would need to be, at all times, kept corrected to date. This is manifestly an impossibility.

I therefore recommend the immediate and unconditional repeal of the clause imposing the restriction herein referred to.

With respect to the second clause of the section above quoted, I would respect-

fully suggest that I know of no reason why this Department should be required to furnish detailed statements of expenditures not required by the general statutes of all the Executive Departments. Not only, however, does the section referred to require every year "a detailed statement of the expenditure of all appropriations" for this Department, but section 11, of the act of Congress approved May 29, 1881, establishing the Bureau of Animal Industry, also requires "an itemized statement of all expenditures under that act." Thus a duplication of a considerable part of this work is made necessary.

I inclose herewith a copy of the statement of the expenditures (House Doc. No. 173, Fifty-sixth Congress) for 1899. It is a document of 234 pages. The cost of its preparation and publication amounts to several hundred dollars. Its value is exceedingly doubtful. Certainly the time of the clerks engaged upon it might be better employed upon other work, and the cost of printing it could be better used in issuing some bulletin of real value to the agricultural interests of the country.

I should not like to be understood as wishing to be relieved of any duty properly imposed by Congress on all the Departments alike. Neither would I seek to avoid any special burden imposed upon this Department if the conditions in this Department differed in any material respect from those existing in other Departments. But I would respectfully suggest that, unless there be some good reason for requiring the detailed statements called for by the section I have quoted, that the requirement be no longer continued.

I therefore respectfully recommend that in the pending bill making appropriations for this Department for the fiscal year ending June 30, 1902, a clause be inserted, or added, in substance as follows:

"That section 2 of the act approved March 3, 1885, chapter 338, Forty-eighth Congress, Session II, imposing restrictions and duties upon the Department of Agriculture not imposed upon the other Executive Departments, be, and the same is hereby, repealed."

I have the honor to be, sir, very respectfully, your obedient servant,

JAMES WILSON, *Secretary*.

IMMEDIATELY AVAILABLE APPROPRIATIONS.

Forty-seven thousand dollars of the appropriations for 1902 was made "immediately available," divided among certain funds, as shown in the following statement. The question of making a part of an appropriation immediately available is assuming a serious aspect. The practice is contrary to the avowed policy of the Department and should not only be discouraged but totally discontinued. During the last two or three years there has developed a decided and growing tendency in that direction. In practically every instance an immediately available appropriation is in the nature of a deficiency to the appropriation of the preceding year, the only difference being in the fact that the amount of the deficiency is carried in the annual appropriation bill instead of in the regular deficiency bill.

Amounts immediately available.

Grass and forage-plant investigations	\$5,000
Bureau of Soils	10,000
Bureau of Chemistry	5,000
Collecting agricultural statistics	3,000
Biological Survey	1,000
Publications	8,000
Tea culture	2,000
Agricultural experiment stations	3,000
Purchase and distribution of valuable seeds	5,000
Plans for building	5,000
Total	47,000

LEASED BUILDINGS, WITH LOCATION AND MONTHLY AND ANNUAL RENTAL.

In the District of Columbia.—The following is a statement of the location, annual rental, and use of the several buildings under lease by the Department in the District of Columbia during the year ended June 30, 1901:

No. 1362 B street SW., Bureau of Animal Industry laboratory	\$1, 800
No. 1358 B street SW., Division of Botany laboratory	720
No. 1364 B street SW., Division of Chemistry laboratory	2, 500
No. 212 Thirteenth street SW., Division of Vegetable Physiology and Pathology laboratory	660
No. 214 Thirteenth street SW., Division of Soils laboratory	660
Total	6, 340

Outside the District of Columbia.—The following are the Bureau of Animal Industry, Division of Botany, and Weather Bureau stations under lease by the Department outside of the District of Columbia during the year ended June 30, 1901:

BUREAU OF ANIMAL INDUSTRY.

Stations, with location and monthly or annual rental.

Station.	Location.	Rent.
Baltimore, Md	No. 215 St. Paul street	\$125 per annum.
Boston, Mass	No. 44 Kilby street	\$30 per month.
Buffalo, N. Y	East Buffalo Live Stock Exchange Building	Do.
Chicago, Ill	No. 493 South Halsted street	\$225 per month.
Do	Union Stock Yards, Center and Exchange avenues.	\$75 per month.
Garfield, N. J.	(Quarantine station)	\$1, 800 per annum.
Indianapolis, Ind	35 Live Stock Exchange Building	\$10 per month.
Kansas City, Kans	Corner Central and James streets	\$45 per month.
Do	Live Stock Exchange Building	\$16. 50 per month.
Littleton, Mass.	(Quarantine station)	\$250 per annum.
Louisville, Ky	No. 507 Johnson street	\$10 per month.
National Stock Yards, Ill.	Live Stock Exchange Building	\$50 per month.
New York, N. Y	No. 18 Broadway	\$500 per annum.
Do	No. 109 West Forty-second street	\$40 per month.
Norfolk, Va	No. 70 Plume street	\$210 per annum.
San Francisco, Cal	87 Flood Building	\$20 per month.
South St. Joseph, Mo	St. Joseph Stock Yard Company Building	\$45 per month.
St. Denis, Md	(Quarantine station)	\$225 per annum.
Cheyenne, Wyo	Warren Block, Sixteenth street	\$45 per month.
Cincinnati, Ohio	Exchange Building, Jackson street	\$180 per annum.
Milwaukee, Wis	Gross Building	\$17 per month.
Knoxville, Tenn	The Deaderick Building	\$10 per month.

DIVISION OF BOTANY.

Kensington, Md	\$50 per annum.
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WEATHER BUREAU.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.

No.	Station.	Location.	Amount.	Rent.
UNITED STATES STATIONS.				
1	Abilene, Tex.	On South First street.	a \$424.45	Heat, cleaner, oil, matches, ink, mucilage, brooms, ice, and water.
2	Albany, N. Y.	In public building, corner Broadway and State street.	a 211.36	Heat, cleaner, light, oil, matches, ink, and mucilage.
3	Alpena, Mich.	Corner Fletcher and Dock streets.	a 120.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and ice.
4	Amarillo, Tex.	Corner Polk and Fifth streets.	a 252.00	Heat, cleaner, light, and ice water.
5	Astoria, Oregon.	No. 545 Commercial street.	a 900.00	Heat and janitor service.
6	Atlanta, Ga.	In Prudential Building, corner Broad, Walton, and Forsyth streets.	a 360.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
7	Atlantic City, N. J.	In Real Estate and Law Building, 1421 Atlantic avenue.		
8	Augusta, Ga.	In public building, corner Campbell and Greene streets.	a 350.00	Electric light and telephone.
9	Baker City, Oregon.	In Pollman Building, Main street.		Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and use of cellar.
10	Baltimore, Md.	Johns Hopkins University, 532 North Howard street.	b 20.00	For exposure of wind instruments.
11	Birmingham, N. Y.	In public building, corner Wall and Henry streets.	a 480.00	Heat, janitor service, light, hot and cold water.
12	Birmingham, Ala.	In Walker & Jordan Building, 2011 First avenue.		
13	Bismarck, N. Dak.	In public building, corner Main and First streets.	a 559.97	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and use of cellar.
14	Block Island, R. I.	On Main street.	b 20.00	For exposure of wind instruments.
15	Boise, Idaho.	On corner of National Hotel, on Main street.	a 480.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, electric current for motor of printing press, Rent of ground.
16	Boston, Mass.	In Sonoma Building, No. 228 Main street.		
17	Buffalo, N. Y.	In public building, Post-Office square.	a 539.85	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, electric current for motor of printing press, Rent of ground.
18	Buxton, N. C.	In Prudential Building, corner Pearl and Church streets.	b 40.00	Heat, cleaner, and light.
19	Cauro, Ill.	Near Buxton, Dare County, N. C.		
20	Cape Henry, Va.	In public building, corner Washington avenue and Fourteenth street.		
21	Cape May, N. J.	In Weather Bureau Building, on the beach.	a 420.00	Heat, cleaner, and light.
22	Cape May, N. J.	No. 310 Hughes street.		
23	Carson City, Nev.	In public building, on Carson street.		
24	Charleston, S. C.	In public building, 240 East Bay street.		
25	Charlotte, N. C.	In public building, corner Trade and Mint streets.		
26	Chattanooga, Tenn.	In public building, corner Eleventh and A streets.		
27	Cheyenne, Wyo.	In Commercial Building, 216-218 West Sixteenth street.	a 517.61	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.

a In accordance with existing lease.

b Under written agreement, lease being impracticable.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

No.	Station.	Location.	Amount.	Rent. Includes—
UNITED STATES STATIONS—continued.				
27	Chicago, Ill.	Auditorium Building, corner Wabash avenue and Congress street.	a \$1,800.00	Heat, cleaner, light, oil, matches, ink, mucilage, ice, water, soap, and elevator.
28	Cincinnati, Ohio.	In public building, Fifth street between Walnut and Main streets.		
29	Cleveland, Ohio.	In Society for Savings Building, corner Public Square and Ontario streets.	a 1,140.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, toilet supplies, power for electric motor, gas for stereotyping, electricity for signals, and storeroom.
30	Columbia, Mo.	In Agricultural College Building, campus State University.		
31	Columbia, S. C.	In City Hall, northwest corner Main and Gervais streets.	a 330.00	Heat, cleaner, and light.
32	Columbus, Ohio.	In Eberly Block, 343-245 South High street.	a 616.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, washing towels and flags, rent of telephone, gas for stereotyping, electric power for press, and district messenger service (mail to and from post office).
33	Concordia, Kans.	Post-office building, 204 Sixth street.	a 292.00	Heat, cleaner, light, matches, and ice.
34	Corpus Christi, Tex.	In Hatch and Robertson Building, corner Mesquite and Peoples streets.	a 259.00	Heat, cleaner, and light.
35	Carrivutuck Inlet, N. C.	In United States Life Saving Station Building.		
36	Davenport, Iowa.	In public building, corner Fourth and Perry streets.		
37	Denver, Colo.	In public building, corner Sixteenth and Arapahoe streets.		
38	Des Moines, Iowa.	In public building, corner Fifth street and Court avenue.		
39	Detroit, Mich.	Union Trust Building, corner Griswold and Congress streets.	a 670.00	Heat, cleaner, electric light and power, oil, matches, ink, mucilage, brooms, ice, water, soap, and elevator.
40	Dodge, Kans.	Beeson Block, on Front street.	a 355.65	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, soap, brushes, stove polish, and lavatory.
41	Dubuque, Iowa.	In Bank and Insurance Building, corner Main and Ninth streets.	a 400.00	Heat, cleaner, light, and water.
42	Duluth, Minn.	In public building, First street and Fifth avenue, west.		
43	East, Alaska.	Corner Front street and Columbus avenue.		
44	East Clallam, Wash.	In telegraph office, Frontier street.	a 100.00	Heat, cleaner, and light.
45	Eastport, Me.	In public building, corner Water and Washington streets.		
46	Elkins, W. Va.	In Warfield & Dunn Building, corner Third street and Davis avenue.	a 300.00	Heat, cleaner, washing towels, light, oil, matches, ice, and water.
47	El Paso, Tex.	In public building, St. Louis and Oregon streets.		
48	Erie, Pa.	In public building, Park Row and State street.		
49	Escanaba, Mich.	In Semer Block, corner Ludington street and Harrison avenue.	a 450.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, and soap.

50	Eureka, Cal.	In Buhne's brick building, corner Second and G streets.	<i>a</i> 375.00	Heat, cleaner, light, oil, matches, ink, muclage, brooms, and water.
51	Evansville, Ind	In Federal Building, Second street between Vine and Sycamore streets.	<i>a</i> 600.00	Heat, cleaner, light, and ice.
52	Flagstaff, Ariz.	In Milligan Cottage, corner Aspen avenue and Park street.		
53	Fort Smith, Ark	In public building, on Sixth street.	<i>a</i> 400.00	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, mops, and telephone service.
54	Fort Worth, Tex	In public building, corner Jennings avenue and Texas street.	<i>a</i> 600.00	Heat, cleaner, light, water, elevator, brooms, ice, and soap.
55	Fresno, Cal	Farmers' National Bank of Fresno Building, No. 1056 1 street.	<i>a</i> 237.29	Heat, cleaner, light, oil, matches, ink, muclage, and brooms.
56	Galveston, Tex	In Improvement, Loan and Trust Building, 2222 Post Office street.	<i>a</i> 480.00	Heat, janitor service, light, oil, matches, water, soap, and towels.
57	Grand Haven, Mich	Cutler House, corner Third and Washington streets.	<i>a</i> 300.00	Heat, cleaner, light for office and storm warnings, matches, ink, muclage, brooms, and soap.
58	Grand Junction, Colo	In Canon Block, corner Fourth and Main streets.		
59	Green Bay, Wis	In Parmentier Block, 324-328 Washington street.		
60	Hamibal, Mo	In public building, corner Broadway and Sixth street.	<i>a</i> 151.50	Heat, cleaner, light, oil, matches, ink, muclage, brooms, and soap.
61	Harrisburg, Pa	In public building, corner Third and Walnut streets.	<i>a</i> 360.00	Heat, cleaner, light, matches, brooms, ice, and water.
62	Hatteras, N. C	In Styron's house, main road.	<i>a</i> 588.00	Heat, cleaner, and light.
63	Havre, Mont	In Gussenhoven Building, First street, between Third and Fourth avenues.	<i>a</i> 375.00	Heat, hot and cold water.
64	Helena, Mont	In Power Block, corner Main street and Sixth avenue.		
65	Houghton, Mich	In Sheldon Building, northwest corner Sheldon and Isle Royale streets.	<i>a</i> 400.00	Heat, cleaner, light, matches, ink, muclage, brooms, ice, soap, and water closet.
66	Huron, S. Dak	In Jeffris Block, 337 Dakota avenue.	<i>a</i> 270.00	Heat, cleaner, light, matches, and water.
67	Independence, Cal	In Norman House, corner Market and Edward streets.	<i>a</i> 1,000.00	Heat, cleaner, light, oil, matches, ink, muclage, brooms, and ice.
68	Indianapolis, Ind	In Majestic Building, corner Pennsylvania and Maryland streets.	<i>a</i> 558.00	Heat, cleaner, and light.
69	Ithaca, N. Y	In Lincoln Hall, Cornell University.	<i>a</i> 270.00	Heat, cleaner, and janitor service.
70	Jacksonville, Fla	In Astor Building, 128 west Bay street.	<i>a</i> 600.00	Heat, cleaner, light, brooms, ice water, and water.
71	Jupiter, Fla	In Weather Bureau Building near light-house.		
72	Kalspell, Mont	In Conrad National Bank Building, corner Main and Second streets.	<i>a</i> 470.30	Cleaner, light, oil, matches, ink, muclage, brooms, ice, and water.
73	Kansas City, Mo	In Rialto Building, corner Grand avenue and Ninth street.		
74	Keokuk, Iowa	In public building, corner Seventh and Blendeau streets.	<i>a</i> 300.00	Heat, cleaner, light, matches, brooms, and ice.
75	Key West, Fla	In Waite Building, corner Duval and Wall streets.		
76	Kittyhawk, N. C	In Weather Bureau Building, on the beach.		
77	Knoxville, Tenn	University of Tennessee.		
78	La Crosse, Wis	In public building, corner Fourth and State streets.		
79	Lander, Wyo	In Bunce & Hunt's Block, No. 30 Main street.	<i>a</i> 420.00	Heat, light, water, use of toilet, washstand, use of roof, and janitor service.
80	Lausang, Mich	In Federal Building, corner Michigan and Capitol avenues.		
81	Lewiston, Idaho	In Dent and Butler Building, 319 E street.		

a In accordance with existing lease.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

No.	Station.	Location.	Amount.	Rent. Includes—
UNITED STATES STATIONS—continued.				
82	Lexington, Ky.	In State College Building, South Limestone street.	.....
83	Lincoln, Nebr.	In University of Nebraska Building, corner Twelfth and T streets.	.....
84	Little Rock, Ark.	In public building, on Second street between Center and Spring.	.....
85	Los Angeles, Cal.	In Wilson Building, 102½ South Spring street.	a \$563.30	Heat, cleaner, light, matches, ink, muelage, brooms, ice, and water.
86	Louisville, Ky.	In public building, corner Fourth and Chestnut streets.	.....
87	Lynchburg, Va.	In Law Building, 807 Main street.	a 270.00	Heat, cleaner, light, matches, ink, muelage, brooms, ice, water, and soap.
88	Macon, Ga.	In public building, corner Third and Mulberry streets.	.....
89	Manteo, N. C.	At Weirs Point, near Manteo, N. C.	b 40.00 b 93.00	Rent of ground. Heat, cleaner, light, oil, matches, brooms, ice, soap, and water.
90	Marquette, Mich.	In Marquette County Savings Bank, southeast corner Washington and Front streets.	a 300.00	Heat and water.
91	Memphis, Tenn.	In Porter Building, corner Main and South Court streets.	a 600.00	Heat, cleaner, light, water, and elevator.
92	Meridian, Miss.	In public building corner Twenty-second avenue and Eighth street.	.....
93	Miles City, Mont.	In Leighton Building, on Main street.	a 108.00	Heat, light, oil, matches, ink, muelage, brooms, and ice.
94	Milwaukee, Wis.	In public building, Wisconsin street, between Jefferson and Jackson streets.	.....
95	Minneapolis, Minn.	In public building, corner Third street and First avenue, south.	.....
96	Mobile, Ala.	In public building, corner St. Francis and Royal streets.	.....
97	Modena, Utah	In Utah and Pacific Railroad depot.	a 180.00	Heat, cleaner, light, matches, brooms, and exposure for instruments.
98	Montgomery, Ala.	In public building, corner Lawrence street and Dexter avenue.	.....
99	Moorhead, Minn.	In First National Bank, corner Front and Sixth streets.	a 265.25 a 420.00	Heat, cleaner, light for office, matches, ink, muelage, brooms, ice, water, and soap. Heat, light, oil, matches, ink, muelage, brooms, water, and transportation for employees and supplies.
100	Mount Tamalpais, Cal.	In observatory building, eastern peak Mount Tamalpais.	a 5.00	For rent of ground on which Weather Bureau Building is located.
101	Mount Washington, N. H.	On summit.	a 270.00	Heat, light, ink, muelage, brooms, ice, water, and electric light for signals.
102	Nantucket, Mass.	In Pacific Club House, corner Main and Water streets.	.....

103	Narragansett Pier, R. I.	In Odlen Cottage, Kingstown street.			Heat, light, matches ink, muelage, and brooms.
104	Nashville, Tenn.	In Chamber of Commerce, No. 369 Church street.	a 150.96	b 496.00	Heat, cleaner, light, matches, ink, muelage, brooms, ice, and soap.
105	Neah Bay, Wash.	In Indian agency building, facing bay.			
106	New Brunswick, N. J.	In New Jersey experiment station building, corner Bleeker place and Hamilton street.			Heat, cleaner, and light.
107	New Haven, Conn.	In Insurance Building, No. 890 Chapel street.	a 384.00		
108	New Orleans, La.	In public building, corner Decatur and Customhouse streets.			
109	New York, N. Y.	In American Surety Building, 100 Broadway.	a 2,500.00		Heat, cleaner, light for office and signals, electricity or gas for stereotyping, electric current for printing press, use of flagstaff, elevators, roof, and storage for property.
110	Norfolk, Va.	In Citizens' Bank Building, 191-195 Main street.	a 525.00		Heat, cleaner, light, matches, ink, muelage, brooms, ice, and soap.
111	Northfield, Vt.	In Norwich University, on Central street.			Heat, cleaner, light, ink, muelage, brooms, ice, and water.
112	North Platte, Nebr.	In Odd Fellows' Hall, corner Fifth and Dewey streets.	a 339.50		
113	Oklahoma, Okla.	In Opera House Block, corner Robinson street and Grand avenue.	a 510.00		
114	Omaha, Nebr.	In public building, corner Sixteenth and Dodge streets.			
115	Oswego, N. Y.	In public building, Oneida street.			
116	Palestine, Tex.	In City Hall, corner of Palmer and Oak streets.	a 314.00		Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, water, and soap.
117	Parkersburg, W. Va.	In public building, corner Fifth and Juliana streets.			
118	Pensacola, Fla.	In public building, corner Palafox and Government streets.	a 300.00		
119	Phoenix, Ariz.	In Wharton Building, No. 38 North Center street.			
120	Philadelphia, Pa.	In public building, corner Ninth and Chestnut streets.	a 240.00		Heat, light, matches, ink, muelage, brooms, ice, water, and soap.
121	Pierre, S. Dak.	In Geiger's Block, Pierre street, near Dakota avenue.			
122	Pittsburg, Pa.	In public building, Smithfield street, Third to Fourth avenues.			
123	Pocastello, Idaho.	In Cook Building.	360.00		Heat, cleaner, light, and water.
124	Point Reyes Light, Cal.	In light-house building.	a 96.00		
125	Port Crescent, Wash.	In Hart Building, corner Third and A streets.	a 591.00		Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, and soap.
126	Port Huron, Mich.	In Federal Building, corner Sixth and Water streets.	b 840.00		
127	Portland, Me.	First National Bank, 57 Exchange street.	a 240.00		Heat, cleaner, light, and water.
128	Portland, Oregon.	In Oregonian Building, corner Sixth and Alder streets.			Water rent for water-closet.
129	Pueblo, Colo.	In public building, corner Sixth and Main streets.	a 276.00		Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, water, soap, brushes, dusters, and towels.
130	Raleigh, N. C.	In Fisher Building, corner Fayetteville street and Exchange place.	a 396.25		Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, and soap.
131	Rapid City, S. Dak.	In Lakota Building, corner Seventh and St. Joe streets.	a 600.00		Heat, cleaner, light, water, elevator, electric power for press, and gas for stereotyping furnace.
132	Red Bluff, Cal.	In Bank of Tehama County, Cal., corner of Main and Walnut streets.			
133	Richmond, Va.	In Times Building, corner Bank and Tenth streets.			
134	Rochester, N. Y.	In public building, corner Church and Fitzhugh streets.			

a In accordance with existing lease.

b Under written agreement, lease being impracticable.

Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.

No.	Station.	Location.	Amount.	Rent.
UNITED STATES STATIONS—continued.				
135	Roseburg, Oregon	In Marks Building, 228½ Jackson street	\$900.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, water, soap and chimneys.
136	Sacramento, Cal.	In public building, corner Seventh and K streets	.....
137	St. Louis, Mo.	In public building, on Olive street, between Eighth and Ninth	.....
138	St. Paul, Minn.	In Chamber of Commerce Building, 112 East Sixth street	\$72.85	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, soap, and chimneys.
139	Salt Lake City, Utah.	In Doody Block, corner West Temple and Second South streets.	\$600.00	Heat, cleaner, light, matches, brooms, water, and elevator.
140	San Antonio, Tex.	In Hicks Building, corner Avenue C and East Houston street	\$480.00	Heat, cleaner, and water.
141	San Diego, Cal.	In Keating Building, corner Fifth and F streets	\$360.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
142	Sandusky, Ohio	In public building, corner Columbus avenue and Market street.	.....
143	San Francisco, Cal.	In Mills Building, corner Bush and Montgomery streets	\$4,290.00	Heat, cleaner, light, water, electric power for printing press, and gas for stereotyping.
144	San Luis Obispo, Cal.	In Rackliffe Building, corner Choro and Marsh streets.	\$300.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
145	Santa Fe, N. Mex.	In Catron Building, corner Plaza on Palace avenue.	\$200.00	Heat, light, and water.
146	Sault Ste. Marie, Mich.	In Weather Bureau Building on Government reservation known as "Canal grounds."	.....
147	Savannah, Ga.	In public building, corner President and Whitaker streets.	.....
148	Scranton, Pa.	In Connell Building, 127 Washington avenue	\$475.00	Heat, cleaner, and light.
149	Seattle, Wash.	In New York Building, No. 704 Second avenue.	\$480.00	Heat, cleaner, light, and water.
150	Shreveport, La.	In public building, corner Texas and Marshall streets.	.....
151	Sioux City, Iowa.	In public building, corner Sixth and Douglas streets.	.....
152	Spokane, Wash.	In Jamieson Building, 705 Riverside avenue.	\$540.00	Heat, cleaner, light, and water.
153	Springfield, Ill.	In public building, corner Monroe and Sixth streets.	.....
154	Springfield, Mo.	In public building, corner Booneville and Brower streets.	.....
155	Tacoma, Wash.	In Chamber of Commerce Building, corner C and Ninth streets.	\$240.00	Heat, cleaner, and light.
156	Tampa, Fla.	In Knight Building, No. 315½ Franklin street.	\$328.75	Heat, cleaner, light, matches, ink, mucilage, and ice.
157	Toledo, Ohio.	In public building, corner Madison and St. Clair streets	.....
158	Topeka, Kans.	In Columbia Building, 112 west Sixth avenue	\$350.00	Heat, cleaner, light, ink, mucilage, brooms, ice, and water.
159	Twin, Wash.	In Jones Building	\$100.00	
160	Valentine, Nebr.	In Deepenport Building, corner Catherine and Main streets.	\$400.00	Heat, cleaner, light, oil, matches, and brooms.

161	Vicksburg, Miss.....	In public building, corner Crawford and Walnut streets.....	.....	Heat, cleaner, brooms, and soap.
162	Walla Walla, Wash.....	In Paine Brothers' Building, corner Main and Second streets.....	a 295.80	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
163	Wichita, Kans.....	In The Sedgwick, corner First and Market streets.....	a 330.00	Heat, cleaner, and light.
164	Williston, N. Dak.....	Corner Main and Third streets.....	a 330.00	Heat, cleaner, and light.
165	Wilmington, N. C.....	In public building, corner Front and Chestnut streets.....	.....	Heat, cleaner, light, matches, ink, mucilage, brooms, and water.
166	Winumucca, Nev.....	In county court-house, on Bridge street.....	a 285.00	Heat, cleaner, and light.
167	Yankton, S. Dak.....	In Union Block, corner Third and Walnut streets.....	a 280.00	
168	Yuma, Ariz.....	In public building, on Government reservation.....	.....
	Total.....	.....	42,209.64	
WEST INDIAN STATIONS.				
169	Basseterre, St. Kitts.....	In American House, Liverpool row.....	b 288.00	Observatory platform and storage.
170	Bridgetown, Barbados.....	In ice house, corner McGregor and Broad streets.....	b 352.00	Cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and towels.
171	Cienfuegos, Cuba.....	In Union Hotel, No. 19 D'Clouet street, corner San Fernando.....	b 480.00	Janitor, light, water, washing towels, and use of roof.
172	Havana, Cuba.....	At No. 67 Prado, Belots Baths.....	b 1,200.00	Cleaner, light, water, and soap.
173	Kingston, Jamaica.....	In Hacienda, between Obispo and Obriplia streets.....	b 438.00	Water rates, taxes, and exposure instruments.
174	Port of Spain, Trinidad.....	In Halfway Tree, 3 miles north of Kingston.....	b 300.00	Cleaner, light, oil, matches, brooms, ice, and water.
175	Puerto Principe, Cuba.....	In Family Hotel, No. 48 King street.....	b 300.00	Janitor service and water.
176	Roseau, Dominica.....	In San Francisco College, San Francisco square.....	b 240.00	Office room, storage, cellar, and platform on roof.
177	San Juan, Porto Rico.....	In Bow Lane House, corner Hanover street and Bow lane.....	.....	Water.
178	Santiago de Cuba, Cuba.....	No. 5 Portaleza street.....	a 600.00	
179	Santo Domingo, Santo Domingo.....	Corner of Nepomuceno and Enramadas, baja, No. 10.....	b 380.00	
180	Willemsstad, Curaçao.....	In Vichni Building, No. 7 Santo Tomas street.....	a 480.00	
	Total.....	In Washington Villa, on Hoogstraet.....	b 341.40	Cleaner, electric light, water, ice, and bridge tolls.

a In accordance with existing lease.

b Under written agreement, lease being impracticable.

REPORT OF THE EDITOR, DIVISION OF PUBLICATIONS.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF PUBLICATIONS,
Washington, D. C., August 26, 1901.

SIR: I have the honor to submit herewith, for your information and consideration, a report on the work of this Division for the fiscal year ended June 30, 1901; also recommendations in regard to future operations.

Respectfully,

GEO. WM. HILL,
Editor and Chief.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

WORK OF DIVISION GOVERNED BY GROWTH OF DEPARTMENT.

Before reviewing the work of the Division of Publications for the year just passed it seems desirable to call attention once more to the fact that, so far as the extent of the work is concerned, there is no control possible save the arbitrary limitation imposed by the amount of the appropriations. The extent of the work to be performed in this Division is absolutely dependent upon the growth of the Department and the activity of its various agencies. This activity depends in its turn upon so many extraneous conditions that no chief of any single Bureau, Division, or Office can even approximate at the beginning of the year the amount of printing which he will require during the year.

CONSEQUENCES OF INADEQUATE APPROPRIATIONS.

Inasmuch as the appropriations for our work are almost invariably inadequate, the facts just recited being apt to be overlooked, unfortunate consequences follow. One of these is the frequent appeal to Congress for a special appropriation for a particular publication much needed in the Department work and in much demand on the part of the public, but which, for want of funds, can not be printed without this special appropriation. The other consequence, and the most to be regretted, is the necessary withholding from publication of much timely and useful matter containing information of great practical utility, but which it is found quite impossible to print from the appropriation available for that purpose. Grievous injustice also ensues from the insufficiency of funds for the distribution of the publications printed, the unavoidable result being that a very large number of

faithful and deserving employees every year have to be furloughed for certain periods of time, causing much individual suffering, as well as working a very great demoralization to the force, to the great disadvantage of the work in the document section.

Of the appeals made to Congress for aid in publishing particular reports during the past year, the majority were successful, thanks to the cordial interest and energy of the honorable chairmen of the House and Senate Committees on Printing; but every year it happens that, unavoidably, especially during a short session, some of these special requests for printing, which are never made except in the most urgent cases, fail to receive favorable action, with most unfortunate results.

The close of the past fiscal year found us with over a score of bulletins in manuscript which had been withheld from publication for want of funds to print. While these were pushed through as rapidly as possible upon the new appropriation becoming available, the delay in their appearance is in every case regrettable and in many cases seriously detrimental to the objects these publications were designed to serve. Another serious result of inadequate appropriations is to be found in our inability to supply reprints when publications are exhausted, even though the Superintendent of Documents reports numerous applications received by him accompanied by cash to pay for the same. The growth in the sale of public documents through the Superintendent of Documents has during the past few years been remarkable, and it seems most unfortunate that circumstances should so often compel us to discourage it. Properly developed, this plan seems to offer the only true solution of the great problem attending the subject of equitable, judicious, and economical distribution of public documents.

NUMBER OF PUBLICATIONS ISSUED.

The total number of publications issued by the Department of Agriculture during the fiscal year ended June 30, 1901, was 606, of which 109 were publications of the Weather Bureau. With the editing and printing of the Weather Bureau publications this Division has no connection, and hence the number of publications issued under the supervision of the Department editor was 497. Of these, 263 were new, aggregating 14,458 printed pages, and the others, 234, were reprints, aggregating 8,818 printed pages. Of the reprints, 157 were Farmers' Bulletins. A list in detail of the publications issued during the year ended June 30, 1901, will be found in Appendix A.

The following shows the classes of publications composing the total 606, arranged according to the funds to which they were respectively charged:

Number and classes of publications, fiscal year 1901.

Publications:	
Chargeable to regular fund	274
Chargeable to divisional funds	86
Chargeable to Farmers' Bulletin fund	171
Printed as Executive documents	16
Printed at Weather Bureau	109
Total	606

The following table shows the number of publications, both original and reprint, and the aggregate number of pages and copies in each class, for the fiscal years 1899, 1900, and 1901:

Number of publications, original and reprint, and number of pages and copies of each class, fiscal years 1899, 1900, and 1901.

Character of publication.	1899.			1900.			1901.		
	Publications.	Pages.	Copies.	Publications.	Pages.	Copies.	Publications.	Pages.	Copies.
Original	191	12,864	4,099,288	225	10,852	4,338,978	262	14,656	3,903,094
Reprint.....	298	11,944	2,274,300	148	5,983	2,004,500	232	9,139	3,115,600
Weather Bureau	114	1,612	702,387	95	1,164	809,000	112	3,341	880,587
Total.....	603	26,420	7,075,975	468	17,999	7,152,478	606	27,136	7,899,281

The above table shows the great activity of the Department in the matter of publications. In the first place the original publications for the year number 262, exclusive of the Weather Bureau, a figure far higher than that of any previous year. The total number of pages in these new publications was also, as was to be expected, greater than ever before, aggregating 14,656. It may be noted that had the printing fund been adequate these figures would have been considerably increased, as there were held over, from want of funds to print, during the last two months of the fiscal year, more than twenty different publications. One feature of the above table deserves particular notice as illustrating the policy adopted with a view to greater economy. A comparison of the number of publications for each of the three years covered by the table with the number of copies shows the tendency toward smaller editions. This is particularly marked in the year just elapsed, where the total number of copies covered by the 263 new publications is considerably less than the total number for 1899, representing only 191 publications. This is the only method available by which this Division can exercise any restriction over the expenditures for printing.

In the case of reprints composed largely, it may be stated, of Farmers' Bulletins, this restriction in the size of the edition is not possible. We find that although the number of reprints in 1901 exceeded the number in 1900 by less than 50 per cent, the increase in the number of copies in 1901 was largely in excess of 50 per cent, aggregating over 3,100,000 copies.

For purposes of comparison, a table is appended showing the total number of copies of all the Department publications, together with the aggregate number of copies issued, for the nine years ended with the 30th of June last. In view of the fact that all the work of the Department is reflected in its publications, this table affords a very interesting illustration of the growth and development of the Department during the last decade. The increase from 210 publications aggregating something over 2,500,000 copies in 1893, to 606 publications aggregating nearly 8,000,000 copies in 1901, bears eloquent testimony to the constant increase in the work of the Department of Agriculture.

Number of publications issued from 1893 to 1901, by years.

Year.	Number of publications.	Total number of copies.
1893	210	2,689,084
1894	205	3,169,310
1895	254	4,100,660
1896	376	6,561,700
1897	424	6,541,210
1898	501	6,280,365
1899	603	7,075,975
1900	468	7,152,428
1901	606	7,899,281
Total	3,647	51,470,013

To complete the record of the year's work a table is given showing the number of publications issued from each Bureau, Division, or Office of the Department, segregating the originals and reprints, and showing also the number of pages in the aggregate number of copies. In the preparation of this table Farmers' Bulletins are not given separately, but are included in the statement of the Bureau, Division, or Office contributing the same. On the other hand, Executive documents, namely, those published by Congress, are enumerated together without reference to the Bureau, Division, or Office from which they emanated.

Number of publications, original and reprint, and pages, by Bureaus, Divisions, and Offices, 1901.

[Farmers' Bulletins are included in the Bureaus, Divisions, and Offices contributing them.]

Bureaus, Divisions, and Offices.	Publications.			Pages.			Number of copies.		
	Original.	Reprint.	Total.	Original.	Reprint.	Total.	Original.	Reprint.	Total.
Secretary's Office	9	6	15	382	206	588	36,900	35,000	71,900
Executive documents	12	4	16	5,226	751	3,977	590,844	42,000	632,844
Accounts and Disbursements	2	2	4	80	80	160	3,200	3,200	6,400
Agrostology	19	10	29	1,214	277	1,491	47,500	180,000	227,500
Animal Industry	24	32	56	800	1,172	1,972	74,200	558,000	632,200
Biological Survey	13	7	20	481	367	848	40,450	44,000	84,450
Botany	14	10	24	820	316	1,136	110,200	134,000	244,200
Chemistry	10	9	19	418	357	775	47,650	83,000	130,650
Entomology	18	23	41	750	572	1,322	127,450	147,500	274,950
Experiment Stations	49	82	131	3,593	3,566	7,159	297,000	1,212,600	1,509,600
Foreign Markets	6	3	9	336	215	551	54,000	3,000	57,000
Forestry	7	8	15	136	405	541	84,500	39,000	123,500
Gardens and Grounds	1	1	2	7	7	14	1,000	1,000	2,000
Library	5	5	10	102	102	204	3,950	3,950	7,900
Plant Industry	1	1	2	40	40	80	30,000	30,000	60,000
Pomology	1	9	10	6	246	252	200	156,500	156,700
Publications	22	6	28	976	176	1,152	771,500	160,000	931,500
Public Road Inquiries	3	10	13	44	312	356	14,000	112,500	126,500
Seed and Plant Introduction	3	3	6	118	118	236	7,500	7,500	15,000
Soils	10	4	14	202	66	268	18,850	57,000	75,850
Statistics	20	20	40	329	329	658	1,503,000	1,503,000	3,006,000
Vegetable Physiology and Pathology	13	9	22	566	135	701	39,200	151,500	190,700
Weather Bureau	108	4	112	3,180	161	3,341	832,587	48,000	880,587
Total	370	236	606	17,836	9,300	27,136	4,735,681	3,163,600	7,899,281

FARMERS' BULLETINS.

The appropriation for the preparation and printing of Farmers' Bulletins was \$57,500, of which \$51,798.63 was expended for printing and \$5,701.37 for the preparation of such bulletins.

During the past year only 14 new Farmers' Bulletins were issued, but the calls for reprints were so numerous that 157 of these were issued, aggregating nearly 3,000,000 copies. The total number of copies of the new bulletins aggregated 415,000. The Congressional distribution, as the tables will show, was larger than ever before, the provision for printing having been increased over the year previous and a considerable number having been left over from June 30, 1900, which by your order were added to the Congressional supply for the fiscal year 1901. This enabled us to make the quota for each Senator, Representative, and Delegate 7,000 copies. The total number of Congressional quotas drawn was 413, aggregating 2,195,010 copies. This left again a considerable number (over 1,000,000), which reverted to the Secretary for the current year. Adding this, as per your direction, to the number it will probably be possible to print, owing to the increased appropriation, will permit of raising the quota for Senators, Representatives, and Delegates for the current year to 15,000 copies. Under the present law four-fifths instead of two-thirds of the total number of Farmers' Bulletins printed are reserved for the use of Congressmen, with, however, the same proviso as heretofore in regard to quotas unused on or before the 30th of June of each year, by which all such quotas revert to the Secretary of Agriculture, to be disposed of at his discretion. So far all surplus copies thus accumulating to the Secretary's credit have been included in the Congressional distribution for the succeeding year.

The appropriation for this Division for the current year includes a provision of \$2,500 for the rent of a building and for such alterations as may be needed to fit it for the storage of publications. In accordance with this provision, a contract for a lease was made for a building to be erected for the accommodation of a portion of the document section in conjunction with the vegetable pathological and physiological investigations. This building is now approaching completion, and the basement and two stories of the eastern side will be placed at the disposal of this Division, which will be occupied for the storage and distribution of Farmers' Bulletins. This will greatly relieve the congested condition of those portions of the building hitherto devoted to the storage and shipment of publications. This relief becomes all the more important in view of the great increase contemplated in the number of Farmers' Bulletins to be published, which will aggregate about 7,000,000 copies.

The tables following show the details connected with the issue of Farmers' Bulletins—the originals and reprints published during the year, with comparative figures for 1900 and 1899, the total cost of printing, the titles and number of copies of the new bulletins, the number contributed by the several Bureaus, Divisions, and Offices, etc. One of these tables shows that the total number of copies of Farmers' Bulletins issued since the first number appeared is 16,975,500, of which there have been distributed upon Congressional orders 10,713,671. The total number of Farmers' Bulletins issued since the beginning, including those now in press, is 139. For a detailed statement of the publications received and distributed during the year, see Appendix B.

Farmers' Bulletins issued 1899-1901, by years.

Originals and reprints of Farmers' Bulletins.	Number of bulletins	Number of copies.
Fiscal year 1901:		
Originals	14	415,000
Reprints	157	2,930,000
Total	171	3,345,000
Fiscal year 1900:		
Originals	18	525,000
Reprints	90	1,835,000
Total	108	2,360,000
Fiscal year 1899:		
Originals	22	520,000
Reprints	154	1,917,000
Total	176	2,437,000

Cost of printing Farmers' Bulletins, 1900-1901.

Item.	Number of bulletins	Number of copies.	Cost.
Fiscal year 1901:			
Paid from Farmers' Bulletin fund	171	3,345,000	\$51,796.68
Fiscal year 1900:			
Paid from Farmers' Bulletin fund	97	2,150,000	30,665.15
Paid from general printing fund	11	210,000	3,469.69
Total	108	2,360,000	34,134.84

New Farmers' Bulletins issued during the fiscal year 1901.

No. of bulletin.	Title of bulletin.	Total number of copies.
119	Experiment Station Work—XV	30,000
120	The Principal Insects Affecting the Tobacco Plant	30,000
121	Beans, Peas, and other Legumes as Food	30,000
122	Experiment Station Work—XVI	30,000
123	Red Clover Seed: Information for Purchasers	30,000
124	Experiment Station Work—XVII	30,000
125	Protection of Food Products from Injurious Temperatures	20,000
126	Practical Suggestions for Farm Buildings	30,000
127	Important Insecticides: Directions for Their Preparation and Use	30,000
128	Eggs and Their Uses as Food	30,000
129	Sweet Potatoes	30,000
130	The Mexican Cotton-Boll Weevil	30,000
131	Household Tests for the Detection of Oleomargarine and Renovated Butter	30,000
132	The Principal Insect Enemies of Growing Wheat	15,000
	Total	415,000

Farmers' Bulletins reprinted during the fiscal year 1901.

No. of bulletin.	Title of bulletin.	Total number of copies.
16	Leguminous Plants for Green Manuring and for Feeding	35,000
17	Peach Yellows and Peach Rosette	20,000
21	Barnyard Manure	50,000
22	The Feeding of Farm Animals	40,000
23	Foods: Nutritive Value and Cost	30,000
24	Hog Cholera and Swine Plague	45,000
26	Sweet Potatoes: Culture and Uses	30,000
27	Flax for Seed and Fiber	20,000
28	Weeds: And How to Kill Them	30,000
29	Souring of Milk and Other Changes in Milk Products	30,000

Farmers' Bulletins reprinted during the fiscal year 1901—Continued.

No. of bulletin.	Title of bulletin.	Total number of copies.
30	Grape Diseases on the Pacific Coast.....	10,000
31	Alfalfa, or Lucern.....	20,000
32	Silos and Silage.....	20,000
33	Peach Growing for Market.....	30,000
34	Meats: Composition and Cooking.....	15,000
35	Potato Culture.....	55,000
36	Cotton Seed and Its Products.....	30,000
37	Kafir Corn: Characteristics, Culture, and Uses.....	20,000
38	Spraying for Fruit Diseases.....	20,000
39	Onion Culture.....	45,000
40	Farm Drainage.....	45,000
41	Fowls: Care and Feeding.....	75,000
42	Facts About Milk.....	55,000
44	Commercial Fertilizers: Composition and Use.....	20,000
45	Some Insects Injurious to Stored Grain.....	10,000
46	Irrigation in Humid Climates.....	20,000
47	Insects Affecting the Cotton Plant.....	10,000
48	The Manuring of Cotton.....	35,000
49	Sheep Feeding.....	20,000
50	Sorghum as a Forage Crop.....	45,000
51	Standard Varieties of Chickens.....	45,000
52	The Sugar Beet: Culture, Seed, Development, Manufacture, and Statistics.....	45,000
54	Some Common Birds in Their Relation to Agriculture.....	20,000
55	The Dairy Herd: Its Formation and Management.....	45,000
56	Experiment Station Work—I.....	15,000
57	Butter Making on the Farm.....	55,000
58	The Soy Bean as a Forage Crop.....	10,000
59	Bee Keeping.....	15,000
61	Asparagus Culture.....	40,000
62	Marketing Farm Produce.....	30,000
63	Care of Milk on the Farm.....	45,000
64	Ducks and Geese: Standard Breeds and Management.....	25,000
65	Experiment Station Work—II.....	15,000
66	Meadows and Pastures: Formation and Cultivation in the Middle Eastern States.....	30,000
67	Forestry for Farmers.....	30,000
69	Experiment Station Work—III.....	30,000
70	The Principal Insect Enemies of the Grape.....	15,000
71	Some Essentials in Beef Production.....	45,000
73	Experiment Station Work—IV.....	10,000
74	Milk as Food.....	30,000
75	The Grain Smuts: How They Are Caused and How to Prevent Them.....	30,000
76	Tomato Growing.....	45,000
77	The Liming of Soils.....	15,000
78	Experiment Station Work—V.....	15,000
79	Experiment Station Work—VI.....	15,000
80	The Peach Twig-Borer: An Important Enemy of Stone Fruits.....	35,000
81	Corn Culture in the South.....	30,000
84	Experiment Station Work—VII.....	15,000
85	Fish as Food.....	30,000
86	Thirty Poisonous Plants.....	30,000
87	Experiment Station Work—VIII.....	10,000
89	Cowpeas.....	30,000
90	The Manufacture of Sorghum Sirup.....	25,000
91	Potato Diseases and Their Treatment.....	40,000
92	Experiment Station Work—IX.....	15,000
94	The Vegetable Garden.....	60,000
95	Good Roads for Farmers.....	100,000
96	Raising Sheep for Mutton.....	30,000
99	Three Insect Enemies of Shade Trees.....	35,000
100	Hog Raising in the South.....	15,000
101	Millet.....	15,000
102	Southern Forage Plants.....	25,000
103	Experiment Station Work—XI.....	15,000
104	Notes on Frost.....	45,000
105	Experiment Station Work—XII.....	15,000
106	Breeds of Dairy Cattle.....	110,000
107	Experiment Station Work—XIII.....	15,000
109	Farmers' Reading Courses.....	80,000
110	Rice Culture in the United States.....	10,000
111	The Farmers' Interest in Good Seed.....	35,000
112	Bread and the Principles of Bread Making.....	50,000
113	The Apple and How to Grow It.....	50,000
114	Experiment Station Work—XIV.....	20,000
116	Irrigation in Fruit Growing.....	30,000
117	Sheep, Hogs, and Horses in the Pacific Northwest.....	60,000
118	Grape Growing in the South.....	60,000
119	Experiment Station Work—XV.....	20,000
121	Beans, Peas, and Other Legumes as Food.....	60,000
122	Experiment Station Work—XVI.....	30,000
Total.....		2,930,000

Farmers' Bulletins contributed by Bureaus, Divisions, and Offices, 1901.

Bureaus, Divisions, and Offices.	New bulletins and reprints.	Number of copies.	Cost.
Secretary's Office.....	2	30,000	\$450.99
Agrostology.....	8	165,000	2,319.94
Animal Industry.....	27	515,000	8,588.88
Biological Survey.....	1	20,000	404.19
Botany.....	8	155,000	1,994.24
Chemistry.....	5	100,000	1,576.70
Entomology.....	12	225,000	3,775.33
Experiment Stations.....	74	1,355,000	20,173.88
Forestry.....	2	30,000	601.27
Plant Industry.....	1	30,000	641.08
Pomology.....	6	150,000	2,209.92
Publications.....	8	210,000	3,555.36
Public Road Inquiries.....	4	100,000	2,137.07
Soils.....	2	45,000	587.04
Vegetable Physiology and Pathology.....	8	150,000	1,823.25
Weather Bureau.....	3	65,000	947.54
Total.....	171	3,345,000	51,796.68

Number of copies of Farmers' Bulletins issued (Nos. 1 to 132) and number distributed to Members of Congress, 1894-1901.

Date.	Total number of copies issued.	Congressional distribution.
Prior to 1894.....	540,000	-----
In 1894.....	278,500	-----
In 1895.....	1,567,000	885,770
In 1896.....	1,891,000	1,316,695
In 1897.....	2,387,000	1,967,237
In 1898.....	2,170,000	1,580,065
In 1899.....	2,437,000	1,101,985
In 1900.....	2,360,000	1,686,909
In 1901.....	3,345,000	2,195,010
Total.....	16,975,500	10,713,671

New Farmers' Bulletins issued in each year from 1895 to 1901, inclusive.

Year.	Number of bulletins.
In 1895.....	11
In 1896.....	13
In 1897.....	16
In 1898.....	21
In 1899.....	22
In 1900.....	18
In 1901.....	14
Total.....	115

THE YEARBOOK FOR 1900.

Thanks to the untiring efforts of my assistants and to the energy of the Public Printer, the first delivery of the Yearbook for 1900 was on May 27, 1901. This volume seems to have been, judging by press comment, as well received as any of its predecessors, the only criticism of it, and that a just one, being the extreme bulkiness which the book has assumed. This is largely due to the tendency of contributors to furnish lengthy articles, a tendency which every effort will be made

to check in the preparation of the forthcoming volume, namely, the Yearbook for 1901. In the call for contributions from the several Bureaus, Divisions, and Offices special emphasis has been laid upon the necessity of furnishing shorter articles, and also upon your desire that every chief should, if possible, be represented by a paper in the Yearbook setting forth in a plain and interesting fashion the scope and purpose of some branch of the work carried on under his supervision.

Another cause for the increase in size of this book is the growing demand for a greater variety of information, such as is contained in the Appendix. The readers of the Yearbook have become accustomed to referring to the Appendix for a large amount of information on a great variety of subjects, such as is not, it is believed, brought together in any other publication; and the fact that it is not elsewhere available renders it extremely undesirable to so restrict the limits of the Appendix as to eliminate important information which can not be procured elsewhere.

REQUISITIONS FOR PRINTING.

The total number of requisitions for printing signed by the chief of this Division was 2,746, of which 28 were subsequently canceled, leaving 2,718. Of these, 626 were drawn upon the main office and 2,092 upon the branch office. The number of requisitions issued yearly since 1898 is as follows: In 1898, 1,890; 1899, 2,342; 1900, 2,450; 1901, 2,746. The following statements show the number of requisitions drawn upon the Government Printing Office for the several Bureaus, Divisions, and Offices during the past fiscal year:

MAIN OFFICE.

Requisitions on the main office by Bureaus, Divisions, Offices, etc., 1901.

Secretary's Office	4
Accounts and Disbursements	44
Agrostology	22
Animal Industry	103
Biological Survey	17
Botany	28
Chemistry	26
Entomology	32
Office of Experiment Stations	133
Foreign Markets	14
Forestry	27
Gardens and Grounds	1
Library	21
Plant Industry	1
Pomology	11
Publications	31
Public Road Inquiries	12
Soils	23
Statistics	29
Vegetable Physiology and Pathology	24
Weather Bureau	4
Miscellaneous	19
Total	626

BRANCH OFFICE.

The branch printing office continues to gain in usefulness in spite of the very discouraging conditions under which the work has to be

carried on, owing to its utterly inadequate and unsuitable accommodations; this alone interferes with the full realization of all the facilities which this office should afford in the Department's work, the Public Printer himself having at all times shown the most cordial disposition to increase its usefulness so far as dependent upon him. Special credit is due to Mr. Frank Wallace for the admirable work performed under his supervision, in view especially of the difficulties he has had to contend with for the reason above stated. Since 1899 the total number of copies of publications issued through the branch office has nearly doubled, and this without taking into account the Monthly Crop Reporter, printed for the Division of Statistics, the composition for which is done in the branch office. For the year under consideration, 76 of the total number of requisitions issued upon the branch office were for the printing of publications aggregating 1,319,800 copies.

Requisitions on the branch office by Bureaus, Divisions, Offices, etc., 1901.

Secretary's Office	143
Accounts and Disbursements	38
Agrostology	85
Animal Industry	227
Biological Survey	57
Botany	258
Chemistry	77
Entomology	53
Office of Experiment Stations	171
Foreign Markets	23
Forestry	103
Gardens and Grounds	58
Library	30
Plant Industry	2
Pomology	30
Publications	211
Public Road Inquiries	37
Soils	46
Statistics	292
Vegetable Physiology and Pathology	70
Weather Bureau	2
Miscellaneous	99
Total	2,092
Canceled	28

Job work done in the branch printing office, 1901.

Envelopes	1,576,169
Letter heads and note heads	729,976
Cards	1,436,855
Circulars	326,900
Blanks	4,186,658
Labels and shipping tags	456,261
Franks	4,086,560
Monthly and other lists	677,736
Crop Reporter	1,369,000
Circular letters and other notices	518,040
Miscellaneous	903,317
Total	15,267,472

¹Composition for Crop Reporter for months of August, September, October, November, 1900, and April, May, June, and July, 1901, was performed in branch office. Printing of Crop Reporter for these months was performed at the main office.

Publications printed in the branch printing office, 1901.

Bureaus, Divisions, and Offices.	Requisitions.	Number of copies printed.
Agrostology	9	38,000
Animal Industry	7	50,000
Biological Survey	8	28,000
Botany	5	58,000
Chemistry	2	2,000
Entomology	13	31,500
Experiment Stations	5	11,300
Forestry	3	24,000
Pomology	1	5,000
Publications	16	697,000
Statistics	7	375,000
Total	76	1,319,800

Additional evidence, if any were needed, of the large amount of work done in the branch office is offered by the fact that during the fiscal year 2,324½ reams of paper were used, aggregating a total weight of 52½ tons.

EXPENDITURES FOR PRINTING AND BINDING.

The appropriation for printing and binding was \$110,000, of which \$20,000 was for the use of the Weather Bureau, and over which this office exercised no supervision. Of the \$90,000 for the use of the Department, the expenditures during the year were \$89,427.46, as shown in the accompanying statement. This does not include the total expenditures for printing, however, since various Bureaus, Divisions, and Offices have special funds from which printing may be defrayed, although there is no specific amount set aside for such purpose. The total expenditures from the three funds from which printing may be defrayed, viz, the regular printing fund, the fund for Farmers' Bulletins, and from the special divisional funds are set forth in the subjoined statements. These statements also give the amount expended for each Bureau, Division, and Office of the Department from the general printing fund, and a summary of the expenditures under the several accounts of the Division of Publications for the year. The total expenditures for printing and binding delivered to the Department from July 1, 1900, to June 30, 1901, inclusive, was \$160,462.¹

Amount expended for the various Bureaus, Divisions, and Offices for printing and binding, 1901.

Division of Accounts	\$1,444.65
Bureau of Animal Industry	1,239.16
Division of Agrostology	1,668.54
Division of Biological Survey	2,647.90
Division of Botany	5,215.57
Division of Chemistry	2,650.59
Division of Entomology	2,063.67
Office of Experiment Stations	14,575.73
Section of Foreign Markets	4,592.44
Division of Forestry	5,016.55
Division of Gardens and Grounds	24.01
Library	2,106.29

¹It should be stated that these figures do not cover expenditures for the Weather Bureau, for the use of which \$20,000 of the regular printing fund has been set aside, and whose printing work, as above stated, is entirely segregated from this Division.

Division of Pomology	\$547.42
Division of Publications	3,359.21
Office of Public Road Inquiries	403.60
Division of Soils	2,391.53
Division of Statistics	7,962.42
Division of Vegetable Physiology and Pathology	4,844.28
Miscellaneous	3,534.93
Seed and Plant Introduction	52.28
Printing at branch printing office for the various Bureaus, Divisions, and Offices	23,086.69
Total	89,427.46

Expenditures for printing and binding, total and by funds, 1901.

TOTAL EXPENDITURES.

Divisional publications paid from general fund (not including Farmers' Bulletins)	\$57,907.05
Farmers' Bulletins	51,798.63
Blank books, etc	8,433.72
Branch office (all work)	23,086.69
Divisional publications paid from special funds	17,890.07
Blank books, etc., paid from special funds	1,345.84
Total	160,462.00

EXPENDITURES BY FUNDS.

General printing fund (\$90,000, exclusive of \$20,000 for Weather Bureau):	
Expended for the various Bureaus, Divisions, and Offices	\$66,340.77
Expended for printing at branch office for the various Bureaus, Divisions, and Offices	23,086.69
	\$89,427.46
Farmers' Bulletin fund	51,798.63
Divisional funds:	
Bureau of Animal Industry	6,145.07
Division of Biological Survey	378.07
Division of Botany	497.00
Division of Entomology	575.88
Office of Experiment Stations	6,079.27
Office of Foreign Markets	3,098.06
Division of Statistics	2,462.56
	19,235.91
Total	160,462.00

SALE OF PUBLICATIONS.

The question of an equitable distribution of publications of the Department becomes more and more urgent and difficult every year. The Superintendent of Documents, to whom, under the law, all the publications of this Department should be turned over yearly, except such as are required for official use, not only reports a continued increase of demand, but deplores the fact that we are unable to supply him with a number sufficient to meet the calls upon him.

The desirability of cooperating with this officer in the sale of our publications has been frequently dwelt upon, and it is emphasized every year by the utter inadequacy of the funds at our disposal for printing and thus supplying the demands made upon us. Every year the free miscellaneous distribution needs to be further restricted, and to do this with fairness to all concerned is not only difficult but well-nigh impossible. It will be a great help in the way of keeping the Superintendent of Documents supplied with such of our publications as he has a demand for were the law so amended as to permit the funds received by him from the purchasers, after deducting a certain percentage for

expenses, to be devoted to the reprint, with the approval of the Secretary of Agriculture, of those publications for which the demand continues. In 1900 the sales fell off somewhat from the two years previous, but this was due almost entirely to the cause stated, namely, our inability to supply copies of publications asked for. In 1901 we have been more fortunate, and the result has been seen in the great increase in the number of publications sold. For purposes of comparison, the accompanying table shows not only the sales and receipts for this Department, but for all the other Departments. It will be seen that in 1901 the Superintendent of Documents sold of the publications of the Department of Agriculture 24,127 copies and of all other Departments 9,458. The publications of this Department were, as might be expected, far less costly than those of the other Departments, hence we find that the receipts for the publications of all the other Departments amounted to \$6,862.44 and the receipts for publications of this Department were \$3,220.25. These figures show an extraordinary increase since 1896, the first year that the documents were sold by the Superintendent, the number of publications of this Department sold by him in that year being 2,818 and the receipts \$353.10.

Number of publications sold and amount received, 1898-1901.

Department.	Copies of publications sold.				Amount received.			
	1901.	1900.	1899.	1898.	1901.	1900.	1899.	1898.
Department of Agriculture	24,127	16,905	18,750	17,740	\$3,220.25	\$2,157.65	\$2,154.45	\$2,089.15
All other Departments	9,458	10,928	8,058	3,623	6,862.44	6,744.56	5,401.66	2,448.12
Total	33,585	27,903	26,808	21,363	10,082.69	8,902.21	7,556.11	4,537.27

ILLUSTRATION WORK.

The total number of original drawings, photographs, etc., prepared in the section of illustrations during the year was 2,401, and of wood engravings 23. The total cost of the illustration work was \$8,971.62, of which \$2,400.51 was defrayed from divisional funds.

The following table gives the number and cost of illustrations:

Number and cost of illustrations by Bureaus, Divisions, and Offices, 1901.

Bureaus, Divisions, and Offices.	Illustrations.	Cost of illustrations.	Amount chargeable to divisional funds.	Amount chargeable to Division of Publications' illustration fund.
Agrostology	58	\$120.17	\$120.17	-----
Animal Industry	150	534.11	534.11	-----
Biological Survey	29	116.20	116.20	-----
Botany	1	2.08	-----	\$2.08
Entomology	229	461.08	461.08	-----
Experiment Stations	124	1,003.23	999.79	3.44
Forestry	17	67.43	59.60	7.83
Gardens and Grounds	1	2.32	-----	2.32
Pomology	10	38.39	38.39	-----
Publications	32	39.33	-----	39.33
Soils	8	25.64	24.80	.84
Statistics	2	2.87	2.87	-----
Vegetable Physiology and Pathology	25	51.50	43.50	8.00
Total	486	2,464.35	2,400.51	63.84
Artists' supplies	-----	717.04	-----	717.04
Artists' salaries	-----	5,790.23	-----	5,790.23
Total	-----	8,971.62	2,400.51	6,571.11

¹ Lithographs.

Furnishing duplicates of our illustrations to various correspondents for reproduction in their publications takes up considerable time of our employees. Altogether, 1,457 duplicates were made by us upon the requests of correspondents, the cost thereof being defrayed by the applicants.

A statement in detail of the work of the section of illustrations follows:

Work of the section of illustrations, 1901.

	Number.
Drawings, retouching photographs, photographing on wood, etc., made by the artists in the Division of Publications.....	2,401
Wood engravings.....	23
Requests for duplicate electrotypes.....	177
Duplicate electrotypes furnished to correspondents on request.....	1,457
Requisitions and authorizations.....	141
Illustrations printed or published (not including reprints).....	2,095

THE DOCUMENT SECTION.

During the fiscal year ended June 30, 1901, Farmers' Bulletins to the number of 3,359,881 were received from the Government Printer, and 3,016,353 were distributed, more than two-thirds of these being mailed at the request of Senators, Representatives, and Delegates. Of miscellaneous publications other than Farmers' Bulletins, 3,205,591 copies were received from the Public Printer, and 3,137,671 were distributed to applicants for the same, making a total of 6,154,024 different documents mailed from the document section.

The preparing of addresses, answering of correspondence, and handling of this number of publications entailed upon the document section an amount of clerical and semiclerical work relatively as great as the manual labor involved in wrapping the documents for mailing. Each request for publications and for information concerning publications received in the document section receives careful attention and a prompt reply. In the furtherance of this work, 2,869 letters were prepared for the Secretary's signature, and 8,302 were written for the signature of the Editor-in Chief. In addition to this, 228,253 blank forms, postal cards, and notification slips, bearing the printed signature of the Editor, were mailed to correspondents, and over 176,000 orders were written, filled, entered, and filed for future reference; 3,238,288 franks or envelopes were addressed; and over 60,000 cards were used in indexing the names of the recipients of the more valuable publications.

EXPENDITURES FROM SPECIAL FUND OF THE DIVISION.

The following statement shows the total expenditures during the year from the special appropriation for this Division, including the amounts for preparation and printing of Farmers' Bulletins, for artists and preparation of illustrations, for artists' supplies, and for labor and materials in distribution of documents:

Pay of artists and preparation of illustrations.....	\$5,575.00
Labor in distribution of documents.....	41,186.57
Materials for document section.....	5,115.38
Artists' supplies.....	717.04
Illustrations.....	63.84
Manuscript for publication.....	300.00
Total.....	52,957.83

Preparation of Farmers' Bulletins.....	\$5,601.60
Printing of Farmers' Bulletins	51,798.63
Total.....	57,400.23
Grand total	110,358.06

PUBLICATIONS PRINTED UNDER ACT OR SPECIAL RESOLUTION.

The following is a list of publications not covered by the appropriations for printing, but provided for by act or by special resolution of Congress:

PROVIDED FOR BY ACT OF CONGRESS.

Yearbook of the Department of Agriculture, 1900.
 Expenditures in the Department of Agriculture.
 Annual Reports of the Department of Agriculture for the fiscal year ended June 30, 1900.
 Operations of the Bureau of Animal Industry.
 Sixteenth Annual Report of the Bureau of Animal Industry, for the year 1899.

PROVIDED FOR BY SPECIAL RESOLUTION OF CONGRESS.

Field Operations of the Division of Soils, 1899.
 Peach-Leaf Curl: Its Nature and Treatment.
 Agricultural Resources and Capabilities of Porto Rico.
 Irrigation Investigations in California.
 The Agricultural Experiment Stations in the United States.
 Report on the Agricultural Resources and Capabilities of Hawaii.
 Fourth Report on the Agricultural Investigations in Alaska, 1900.
 Report on the Big Trees of California.
 A Primer of Forestry, Part I: The Forest.
 Progress of the Beet-Sugar Industry in the United States in 1899, with a Supplementary Report on the Cane-Sugar Industry of the Hawaiian Islands.

RECOMMENDATIONS.

COMPENSATION OF ASSISTANTS.

In submitting estimates for the expenses of this Division for the ensuing fiscal year, I feel compelled, in justice to my chief assistants, to call attention to the fact that their remuneration is quite inadequate to the quality and quantity of service rendered by them. The responsibilities of my editorial assistants have greatly increased with the enormous increase of work, and the service exacted of them demands that they should be recognized as assistant editors. In the case of almost every one of them the term editorial clerk is a misnomer. I trust, then, that it will be possible before long to secure for them and for the other meritorious clerks and employees the practical recognition which their services deserve. In justice to them I shall also place on record here the fact that it is very seldom that any one of my principal assistants enjoys the full term of his leave, while every one of them frequently contributes extra labor for the purpose of aiding in the prompt and efficient performance of our work.

What has been said in regard to my principal assistants in the editorial division equally applies to the assistant in charge of the document section, and to several members of our clerical force, especially those having charge of the books and of the supervision of the work of others. In the estimates of next year some transfers have been made from the Farmers' Bulletin roll to the statutory roll, this being, it is understood, in accordance with the wishes of Congress, and some additional clerical force has been included.

NECESSITY FOR ADDITIONAL EMPLOYEES.

The merest reference to the record of the work done preceding these recommendations will afford conclusive evidence of the necessity for a considerable addition to our force, if we are to perform the duties devolving upon us with promptness and efficiency. In this connection it is important to reiterate the fact that it is not in my power in any way to reduce the quantity of work save by good management in its disposition. The amount of work depends entirely upon the general work of all the several Bureaus, Divisions, and Offices in the Department, any addition to which involves, necessarily, an increase in the labors and responsibilities of the Division of Publications, which is the channel through which all published results of work done must reach the public. That a sufficient force be maintained, therefore, in this Division, to secure promptness in the publication of manuscripts submitted, is of such importance as to be represented by a very considerable money value to the country. Delay in publication for a few weeks may frequently postpone all possibility of any practical results from the information given for twelve months.

The distribution of documents is subject to the same conditions as the rest of our work, in this case a great desideratum being promptness and accuracy. The requests for publications and correspondence in regard thereto result in an average of letters received of about 1,000 a day, all of which must be carefully read, in most cases orders transcribed, and in all cases some form of reply sent.

Taking into account the great increase in our work in all directions, the impossibility also of foreseeing the exact amount of work to be done during the next fiscal year, as explained above, and the serious consequence of delay, the necessity for a considerable enlargement of our immediately available resources will, I think, amply account for the increased appropriation asked for—an increase amounting to \$45,800.

ADDITIONAL FARMERS' BULLETINS.

The provision for the current year for Farmers' Bulletins, 80 per cent of which are subject to the orders of Senators, Representatives, and Delegates in Congress, will involve an increase in the total number of bulletins to be handled of $3\frac{3}{4}$ millions at least, to say nothing of the probable increase in our technical and miscellaneous publications. The force which can be maintained upon the present appropriation is utterly inadequate to dispose of this additional work, and unless Congress shall see fit to provide additional funds, available for expenditure during the current year, the work of the distribution of these bulletins must necessarily be intermitted.

It is found quite impossible to obtain any additional service from the teams now employed in the Department, and it will be necessary that, for this Farmers' Bulletin work, a special wagon and team be procured and maintained.

ILLUSTRATION WORK.

Reference to the estimates will show that a special appropriation is asked for illustration work, including also additional assistance when necessary, and for the purchase of valuable manuscripts. The total amount asked for these objects is considerably less than the sum appropriated for illustrations alone ten years ago, when the number of publications was barely one-fifth of those issued to-day.

THE PRINTING FUND.

An increase in the printing fund of \$30,000 was granted by Congress for the present year, \$10,000 of which, however, is for the exclusive benefit of the Weather Bureau. It was believed when the present appropriation was asked for that it would be amply sufficient, but such has not been the case. The large number of publications held up during the close of the last fiscal year and necessarily charged to this year's appropriation will leave actually available for this year's publications very little more than we had last year. The development of the Department and the extension of its several lines of work have been so rapid as to entirely outstrip the development and extension of this Division, the work of which, for the reasons already stated, necessarily reflects, and in fact should keep full pace with, the general work of the Department. The fact that all the information acquired in the several Bureaus, Divisions, and Offices of the Department can be made of use only by being diffused—an obligation specifically recognized in the organic law creating the Department—makes it a simple and logical conclusion that with every extension of work in any branch of the Department corresponding allowance for increased funds for printing must be made. Otherwise some valuable information will have to be suppressed.

SALE OF DOCUMENTS.

On this subject, to which I am unavoidably compelled to refer every year, I can only repeat the remarks of former years, and this with the added weight of additional experience. In spite of the great extent to which our publications are distributed gratuitously, the sales by the Superintendent of Documents continue to increase, and we have that gentleman's assurance that such sales would be far more than doubled were the number of publications placed at his disposal adequate to meet the demand. To do this it would be necessary to reprint publications from time to time, just as often as necessary to meet the continued demand for them. That such was actually the intention of Congress when it adopted the act for the public printing and binding of January 12, 1895, I have no doubt. At the same time, it is obvious that to do this would greatly overtax the printing fund available for the Department's use. An amendment to this act is urgently needed, providing that the sums received by the Superintendent of Documents from the sale of publications should be placed to the credit of the various Departments and added to their printing funds in the hands of the Public Printer, who should retain only a certain percentage, representing the expense of handling the business in the office of the Superintendent. Such an addition to our printing fund would, without doubt, enable us to always respond by means of reprints to the demands for a further supply of any publication by the Superintendent of Documents. A very great saving would be effected and a great extension in the distribution of the useful information acquired in the Department would be secured. If sections 42 and 52 of the act already referred to were amended so as to allow States, municipalities, and public educational or benevolent institutions to obtain, with the approval of the Secretary of Agriculture, and by paying the actual cost of the same, a reasonable number of copies of any publication, or the plates from which the same have been printed, the public would be efficiently served and the present enormous waste arrested. This amendment

should also provide that all free distribution to individuals should be stopped; that all of our publications be placed on sale at the cost of preparing, presswork, and binding, with a small percentage added for handling, and that only emergency circulars be given a free miscellaneous distribution.

With the law thus amended no possible excuse could exist for the restriction as to the number of copies of the publication issued, a restriction which at present declares that no report, publication, or document shall be printed in excess of 1,000 of each in any one fiscal year without authorization therefor by Congress, the only exception to this limitation being the annual reports of the heads of Departments and publications authorized by the Secretary of Agriculture when the same shall not exceed 100 octavo pages. The securing of the authorization of Congress is difficult. Even when Congress is in session an authorization is usually obtainable only by unanimous consent, and during many months, when Congress is not in session, such authorization, of course, is impossible. This restriction therefore seems to seriously hamper the work of the Department, and very often works great injustice to many persons, who have, at considerable expenditure of time, and in some cases of money, assisted the Department in securing the data for a publication. These persons do this usually with the implied understanding that their efforts will be recognized at least with a copy of the publication to which they thus contribute. It is not right that they should be disappointed. With the gratuitous distribution of public documents restricted in accordance with the recommendations made above, there should be no need for this restriction, as it is manifestly proper that certain public institutions should receive each a copy of every publication issued, and the general public should be entitled to as many as it feels disposed to purchase.

THE YEARBOOK.

The grave inconvenience to which the Department is subjected by the small number of copies, in proportion to the total edition, of the Yearbook placed at the disposal of the Secretary, makes necessary an appeal to Congress for a more liberal allowance. In the days when the total number issued of this publication was but 300,000, and when the work of this Department was not one-fourth of what it now is, 30,000 copies were placed at the disposal of the head of this Department, then Commissioner of Agriculture. To-day, with 500,000 copies issued yearly, the same number, 30,000 copies, is placed at the disposal of the Secretary. It seems hardly necessary to add anything to this comparison. Fifty thousand copies, at least, are needed for the use of the Secretary of Agriculture.

UNIFORMITY OF STYLE IN PUBLICATIONS.

Some means should be adopted to secure uniformity of style in the publications of the Department, so as to obviate the present confusion, annoyance, and expense resulting from individual preferences as regards orthography, capitalization, use of italics, compounding of words, etc., in the bulletins and reports of the various Bureaus, Divisions, and Offices. Unfortunately, the idiosyncrasies are too often not indicated in the manuscripts submitted, but are insisted upon after the matter is in proof, and the changes involve considerable expense, frequently amounting to one-third of the original cost of

composition. It is evident, therefore, that with the limited funds allotted for printing for this Department, the practice should be discontinued without delay. It is believed that each Bureau, Division, or Office should be accepted as the authority in regard to the spelling and capitalization of the terms of the particular investigation with which it is concerned, and that its style should be followed when such terms appear in publications of other offices. There is also urgent necessity for uniformity in the spelling of words and terms in general use. These and many other questions might be satisfactorily settled by conferences of a board consisting of representatives from the various Bureaus, Divisions, and Offices, to be held as occasion requires, thus establishing in course of time a definite style for all the publications of the Department.

VARIATIONS IN SIZE OF PUBLICATIONS.

There is a disposition on the part of certain Bureaus, Divisions, and Offices to adopt the quarto or duodecimo size for their publications in place of the octavo, which has been the standard for many years. While there may be occasionally instances in which the departure is justifiable and necessary, it is believed that the change should never be made unless it can not possibly be avoided, as in the case of extensive and complicated tabular matter. Considerations of economy as well as convenience justify the continued use of the octavo size, which is particularly suitable for large editions and general distribution. The quarto, if used at all, should be confined to bulletins of an extremely scientific or technical character, which are usually issued in very limited editions. There is another serious objection to discrepancies in size in the publications, and that is the difficulty of binding them for permanent preservation and for reference. The different sizes can not be bound together, and even if bound separately they can not usually be shelved together in libraries or bookcases. On this account the duodecimo is as objectionable as the quarto. The size known as royal octavo seems to be very generally accepted as most satisfactory for scientific or technical publications.

NEED OF ADDITIONAL OFFICE ROOM.

I feel obliged again to refer to the inadequate quarters assigned to the use of this Division for the editorial force. An additional communicating room is very much needed for the use of the employees engaged in editorial work, proof reading, and indexing, all of which requires freedom from interruption. In the room now occupied, which also serves as the business office, nine employees are crowded, and their work is unavoidably interrupted by the almost perpetual distractions incident to the public business of the office. Furthermore, it is very necessary in the expedition of the work to have the entire force of editorial assistants in one room, or at least very near together, instead of being separated as they now are on different floors of the main building.

GENERAL CARD INDEX OF THE PUBLICATIONS.

With the rapid increase in the number of publications issued there is an increased necessity for the undertaking of the preparation of a card index of all the bulletins and reports, so as to make readily

available the information they contain. One person should constantly be employed at such work, which would result eventually in what might be called an index section or room, where the index should be maintained in cases of modern style, capable of enlargement as necessity required. All that the Division has been able to do along this line is to prepare and keep a card index of the available publications, which serves a very useful purpose.

APPENDIX A.

PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1901.

[The following publications were issued during the year ended June 30, 1901. Those to which a price is attached, with the exception of publications of the Weather Bureau, must be obtained of the Superintendent of Documents, Union Building, Washington, D. C., to whom are turned over all copies not needed for official use, in compliance with section 67 of the act providing for the public printing and binding and the distribution of public documents. Remittances should be made to him by postal money order. Weather Bureau publications to which a price is attached must be obtained from the chief of that Bureau. Applications for those that are for free distribution should be made to the Secretary of Agriculture, Washington, D. C.]

OFFICE OF THE SECRETARY.

	Copies.
Marketing Farm Produce. By George G. Hill, formerly Manager and Editor of the American Farmer, Illinois. Pp. 28, figs. 7. Farmers Bulletin No. 62. (Reprint.) July, 1900	15,000
Reprint, April, 1901	15,000
Work of the Breeder in Improving Live Stock. By John Clay, jr., Chicago, Ill. Pp. ii, 627-642, reprinted from Yearbook of Department of Agriculture for 1899. August, 1900	100
Development of Transportation in the United States. By Angus Sinclair, Editor Locomotive Engineering. Pp. ii, 643-663, reprinted from Yearbook of Department of Agriculture for 1899. August, 1900	100
Sheep and Wool: A Review of the Progress of American Sheep Husbandry. By J. R. Dodge, Special Agent. Pp. 63, figs. 3. Report No. 66. September, 1900. Price, 5 cents	5,000
Reprint, March, 1901	500
Report of the Secretary of Agriculture, 1900. Pp. 76. November, 1900 ..	12,500
Cooperative Grass and Forage Plant Investigations with State Experiment Stations. By Thomas A. Williams, In Charge of Experiment Work. Pp. 14. Circular No. 8. December, 1900	2,500
Reprint, February, 1901	2,500
Report of the Assistant Secretary Upon the Purchase and Distribution of Seeds for 1900. By J. H. Brigham. Pp. ii, 3-6, from Annual Reports, Department of Agriculture, 1900. January, 1900	200
Collection and Distribution of Grass Seeds: Field Work. By C. L. Shear, In Charge of Seed and Field Work, Division of Agrostology. Pp. 11. Circular No. 9. January, 1901	3,500
Foreign Markets for American Agricultural Products. Testimony of Frank H. Hitchcock, Chief of the Section of Foreign Markets, before the Industrial Commission. Pp. 53. Report No. 67. February, 1901. Price, 5 cents	10,000
Catalase, a New Enzym of General Occurrence, with Special Reference to the Tobacco Plant. By Oscar Loew, Division of Vegetable Physiology and Pathology, detailed to the Division of Soils. Pp. 47. Report No. 68. March, 1901. Price, 5 cents	3,000
Cultivation of Tobacco in Sumatra. By Emile Mulder. Pp. 39. Report No. 58. (Reprint.) April, 1901. Price, 5 cents	1,000
Curing and Fermentation of Cigar Leaf Tobacco. By Oscar Loew, of the Division of Vegetable Physiology and Pathology. Pp. 34. Report No. 59. (Reprint.) April, 1901. Price, 5 cents	1,000

CONGRESSIONAL.

	Copies.
Report on the Big Trees of California. Prepared in the Division of Forestry, U. S. Department of Agriculture. Pp. 30, pls. 15, map. August, 1900. Price, 15 cents	1,000
Field Operations of the Division of Soils, with Accompanying Papers. By Thomas H. Means, Frank D. Gardner, Clarence W. Dorsey, Frank K. Cameron, Lyman J. Briggs. Pp. 198, pls. 29, figs. 19, maps 11. Cloth. (Report No. 64.) August, 1900. Price, 95 cents	13,000
Progress of the Beet Sugar Industry in the United States in 1899. With a Supplementary Report on the Cane-Sugar Industry of the Hawaiian Islands. By Charles F. Saylor, Special Agent, and H. W. Wiley, Chemist, U. S. Department of Agriculture. Pp. 200. (H. R. Doc. No. 699, 56th Cong., 1st sess.) September, 1900	8,000
A Primer of Forestry. Part I. The Forest. Pp. 88, frontispiece, pls. 47, figs. 83. Bulletin No. 24, Division of Forestry. Second edition. October, 1900. Price, 35 cents	35,000
Peach Leaf Curl: Its Nature and Treatment. By Newton B. Pierce, in Charge of Pacific Coast Laboratory, Santa Ana, Cal. Pp. 204, pls. 30, figs. 10. Cloth. Bulletin No. 20, Division of Vegetable Physiology and Pathology. Congressional edition. November, 1900. Price, 30 cents	22,000
Annual Reports of the Department of Agriculture for the Fiscal Year Ended June 30, 1900. Pp. lxxviii, 297. Cloth. January, 1901	3,000
Irrigation Investigations in California. Under the direction of Elwood Mead, Expert in Charge of Irrigation Investigations of the Office of Experiment Stations, U. S. Department of Agriculture, assisted by William E. Smythe, Marsden Manson, J. M. Wilson, Charles D. Marx, Frank Soule, C. E. Grunsky, Edward M. Boggs, and James D. Schuyler. Pp. 73. (Senate Doc. No. 108, 56th Cong., 2d sess.) February, 1901	1,722
Expenditures in the Department of Agriculture. Letter from the Secretary of Agriculture, Presenting a Detailed Statement of Expenditures for the Department for the year ending June 30, 1900. Pp. 247. (H. R. Doc. No. 29, 56th Cong., 2d sess.) February, 1901	1,800
Agricultural Resources and Capabilities of Porto Rico. By Seaman A. Knapp, Special Agent in Charge of Agricultural Investigations in Porto Rico. Pp. 32, pls. 7. (H. R. Doc. No. 171, 56th Cong., 2d sess.) February, 1901	1,800
Reprint. March, 1901	2,000
Operations of the Bureau of Animal Industry. Message from the President of the United States, transmitting a report by the Secretary of Agriculture of the Operations of the Bureau of Animal Industry of that Department for the fiscal year ended June 30, 1900. Pp. 84. (Senate Doc. No. 96, 56th Cong., 2d sess.) March, 1901	1,722
Sixteenth Annual Report of the Bureau of Animal Industry for the year 1899. Pp. 790, pls. 41, figs. 45. Cloth. March, 1901. Price, 85 cents	30,000
Fourth Report on the Agricultural Investigations in Alaska, 1900. By C. C. Georgeson, M. S., Special Agent in Charge of Alaska Investigations. Pp. 83, pls. 24. (H. R. Doc. No. 335, 56th Cong., 2d sess.) April, 1901	8,000
Report on the Agricultural Resources and Capabilities of Hawaii. By W. C. Striggs, Ph. D., Director Louisiana Agricultural Experiment Station. Pp. 100, frontispiece, pls. 27. (H. R. Doc. No. 368, 56th Cong., 2d sess.) April, 1901	1,800
Yearbook of the U. S. Department of Agriculture, 1900. Pp. 888, frontispiece, pls. 87, figs. 88. May, 1901. Price, 75 cents	500,000
The Agricultural Experiment Stations in the United States. By A. C. True and V. A. Clarke. The Paris Exposition, 1900. Prepared to Accompany the Experiment Station Exhibit. Contributed to by the Association of American Agricultural Colleges and Experiment Stations. Cloth. Pp. 636, frontispiece, pls. 153. Bulletin No. 80, Office of Experiment Stations. (Reprint.) June, 1901. Price, \$1.25	2,000

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Report of the Chief of the Division of Accounts and Disbursements for 1900. By F. L. Evans. Pp. iii, 233-263, from Annual Reports, Department of Agriculture, 1900. January, 1901	200
Fiscal Regulations of the U. S. Department of Agriculture, Together with Extracts from the Revised Statutes, Decisions of Courts, Rulings of the Comptrollers, Opinions of the Attorneys-General, etc. Pp. 49. Revised edition. June, 1901	3,000

DIVISION OF AGROSTOLOGY.

Copies.

Fodder and Forage Plants Exclusive of the Grasses. By Jared G. Smith. Assistant, Section of Seed and Plant Introduction. Prepared under the direction of F. Lamson-Scribner, Agrostologist. Pp. 86, pls. 2, figs. 46. Bulletin No. 2. Revised edition. July, 1900. Price, 5 cents	5,000
American Grasses—I. (Illustrated.) Descriptions of the Species. By F. Lamson-Scribner, Agrostologist. Pp. 319, figs. 302. Bulletin No. 7. Third edition. July, 1900. Price, 30 cents	1,000
Studies on American Grasses. A Revision of the North American Species of <i>Bromus</i> Occurring North of Mexico. By Cornelius L. Shear, Assistant Agrostologist. Pp. 66, figs. 40. Bulletin No. 23. July, 1900. Price, 5 cents	3,000
Grasses as Sand and Soil Binders. By F. Lamson-Scribner, B. Sc., Agrostologist. Pp. iii, 421-436, figs. 11, reprinted from Yearbook of Department of Agriculture for 1894. August, 1900	2,000
Progress of Economic and Scientific Agrostology. By F. Lamson-Scribner, B. Sc., Agrostologist. Pp. iii, 347-366, figs. 5, reprinted from Yearbook of Department of Agriculture for 1899. August, 1900	2,000
Succulent Forage for the Farm and Dairy. By Thomas A. Williams, Assistant Agrostologist. Pp. ii, 613-626, reprinted from Yearbook of Department of Agriculture for 1899. August, 1900	3,000
Turkestan Alfalfa. By P. Beveridge Kennedy, Expert and Agent in Charge of Experiment Work. Pp. 20, Circular No. 25. (Reprint.) September, 1900	10,000
Southern Forage Plants. Compiled from the Publications of the Division of Agrostology by F. Lamson-Scribner, Agrostologist. Pp. 48, figs. 14. Farmers' Bulletin No. 102. (Reprint.) September, 1900	10,000
Reprint, April, 1901	15,000
Sorghum as a Forage Crop. By Thomas A. Williams, Assistant Agrostologist. Prepared under the direction of the Agrostologist. Pp. 20, fig. 1. Farmers' Bulletin No. 50. (Reprint.) October, 1900	15,000
Reprint, May, 1901	30,000
Millets. By Thomas A. Williams, Assistant Agrostologist. Pp. 28, figs. 6. Farmers' Bulletin No. 101. (Reprint.) October, 1900	15,000
American Grasses—III. (Illustrated.) Descriptions of the Tribes and Genera. By F. Lamson-Scribner, Agrostologist. Pp. 197, figs. 137. Bulletin No. 20. Revised edition. November, 1900. Price, 15 cents	1,000
Agrostological Notes. By F. Lamson-Scribner and Elmer D. Merrill. Pp. 10. Circular No. 27. December, 1900	2,000
Studies on American Grasses.—I. Some Recent Collections of Mexican Grasses. By F. Lamson-Scribner and Elmer D. Merrill. II. Notes on <i>Panicum nitidum</i> Lam., <i>Panicum scoparium</i> Lam., and <i>Panicum pubescens</i> Lam. By F. Lamson-Scribner and Elmer D. Merrill. III. Miscellaneous Notes and Descriptions of New Species. By F. Lamson-Scribner and Carleton R. Ball. Pp. 55, figs. 23. Bulletin No. 24. January, 1901. Price, 5 cents	3,000
Grasses and Fodder Plants on the Potomac Flats. By C. R. Ball, Assistant in Charge of Grass Gardens and Experiments within the District of Columbia. Pp. 18. Circular No. 28. January, 1901	5,000
Report of the Agrostologist for 1900. By F. Lamson-Scribner. Pp. ii, 83-90, from Annual Reports, Department of Agriculture, 1899. January, 1901	1,000
Alfalfa or Lucern. By Jared G. Smith, Assistant Agrostologist. Pp. 24, figs. 3. Farmers' Bulletin No. 31. (Reprint.) January, 1901	20,000
The Grasses in Elliott's Sketch of the Botany of South Carolina and Georgia. By F. Lamson-Scribner, Agrostologist. Pp. 12, figs. 4. Circular No. 29. February, 1901	2,500
New or Little Known Grasses. By F. Lamson-Scribner, Agrostologist. Pp. 8. Circular No. 30. March, 1901	2,500
Bermuda Grass. By A. S. Hitchcock, Assistant Agrostologist. Pp. 6, figs. 2. Circular No. 31. April, 1901	5,000
Some Arizona Grasses. By Elmer D. Merrill, Assistant in Charge of Collections. Pp. 10. Circular No. 32. April, 1901	2,500
Range Grass and Forage Experiments at Highmore, S. Dak. Report of Progress. By F. Lamson-Scribner, Agrostologist. Pp. 5. Circular No. 33. April, 1901	3,000
Meadows and Pastures: Formation and Cultivation in the Middle Eastern States. By Jared G. Smith, Assistant Agrostologist. Pp. 28, figs. 9. Farmers' Bulletin No. 66. (Reprint.) April, 1901	30,000

	Copies.
Cowpeas. By Jared G. Smith, Assistant Agrostologist. Pp. 16, fig. 1. Farmers' Bulletin No. 89. (Reprint.) April, 1901.....	30,000
American Grasses. II. (Illustrated.) By F. Lamson-Scribner, Agrostologist. Pp. 349, figs. 325. Bulletin No. 17. Revised edition. May, 1901. Price, 20 cents.....	1,000
The Cultivated Vetches. By Jared G. Smith, Assistant Agrostologist. Pp. 8, figs. 6. Circular No. 6. Revised. (Reprint.) May, 1901.....	5,000
Aristida Purpurea (Nutt.) and Its Allies. By Elmer D. Merrill, Assistant in Charge of Collections. Pp. 8. Circular No. 34. May, 1901.....	2,500
Agrostological Notes. By F. Lamson-Scribner, Agrostologist, and Elmer D. Merrill. Pp. 6. Circular No. 35. June, 1901.....	2,500

BUREAU OF ANIMAL INDUSTRY.

Some Examples of the Development of Knowledge Concerning Animal Diseases. By D. E. Salmon, D. V. M., Chief of the Bureau of Animal Industry. Pp. iii, 93-134, reprinted from Yearbook of Department of Agriculture for 1899. July, 1900.....	500
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Climate and Crop Bulletin No. 10. May 20, 1901.....	4,400
Climate and Crop Bulletin No. 11. May 27, 1901.....	4,300
Climate and Crop Bulletin No. 12. June 3, 1901.....	4,350
Climate and Crop Bulletin No. 13. June 10, 1901.....	4,350
Climate and Crop Bulletin No. 14. June 17, 1901.....	4,350
Climate and Crop Bulletin No. 15. June 24, 1901.....	4,350
Storm Bulletin No. 1, 1900. West Indian Hurricane, September 1-10, 1900.....	425
Snow and Ice Bulletin. December 4, 1900.....	1,600
Snow and Ice Bulletin. December 11, 1900.....	1,600
Snow and Ice Bulletin. December 18, 1900.....	1,600
Snow and Ice Bulletin. December 25, 1900.....	1,600
Snow and Ice Bulletin. January 2, 1901.....	1,600
Snow and Ice Bulletin. January 8, 1901.....	1,600
Snow and Ice Bulletin. January 15, 1901.....	1,770
Snow and Ice Bulletin. January 22, 1901.....	1,770
Snow and Ice Bulletin. January 29, 1901.....	1,770
Snow and Ice Bulletin. February 5, 1901.....	1,800
Snow and Ice Bulletin. February 12, 1901.....	1,800
Snow and Ice Bulletin. February 19, 1901.....	1,800
Snow and Ice Bulletin. February 26, 1901.....	1,800
Snow and Ice Bulletin. March 5, 1901.....	1,850
Snow and Ice Bulletin. March 12, 1901.....	1,850
Snow and Ice Bulletin. March 19, 1901.....	1,850
Snow and Ice Bulletin. March 26, 1901.....	1,850
Daily weather map (showing weather conditions throughout the United States and giving forecasts of probable changes):	
July, 1900.....	36,600
August, 1900.....	46,520
September, 1900.....	43,840
October, 1900.....	47,556
November, 1900.....	44,418
December, 1900.....	45,768
January, 1901.....	46,888
February, 1901.....	43,920
March, 1901.....	47,238
April, 1901.....	48,030
May, 1901.....	48,080
June, 1901.....	45,940

APPENDIX B.

REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING THE FISCAL YEAR ENDED JUNE 30, 1901.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that Bureau specially charged with such work and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this Division. A list of Weather Bureau publications is given in separate tables.]

Publications other than Farmers' Bulletins received and distributed from July 1, 1900, to June 30, 1901.

Publication.	Received.	Distributed.
Publications printed prior to July 1, 1900		350,742
DIVISION OF ACCOUNTS AND DISBURSEMENTS.		
Report of the Chief for 1900	313	288
Fiscal Regulations of the Department of Agriculture	3,000	
DIVISION OF AGROSTOLOGY.		
Bulletin No. 2 (revised)	5,000	5,198
Bulletin No. 7 (reprint)	1,000	439
Bulletin No. 17 (revised)	1,000	600
Bulletin No. 20 (revised)	1,000	459
Bulletin No. 23	3,125	1,961
Bulletin No. 24	3,000	1,883
Circular No. 6	5,000	949
Circular No. 25	10,000	13,921
Circular No. 27	2,000	823
Circular No. 28	5,000	4,735
Circular No. 29	2,500	1,662
Circular No. 30	2,500	1,555
Circular No. 31	5,000	1,028
Circular No. 32	2,500	1,628
Circular No. 33	3,000	1,330
Circular No. 34	2,500	1,410
Circular No. 35	2,500	270
Report of the Agrostologist, 1900	1,000	205
BUREAU OF ANIMAL INDUSTRY.		
Bulletin No. 25	3,000	2,959
Bulletin No. 26	3,000	1,025
Bulletin No. 27	17,500	12,601
Bulletin No. 28	1,500	1,212
Circular No. 23	30,000	17,048
Circular No. 31	10,000	15,346
Circular No. 32	2,000	721
Circular No. 33	6,000	3,443
Circular No. 34	2,000	1,090
Report of the Chief, 1900	1,200	292
Sixteenth Annual Report of the Bureau of Animal Industry for the Year 1899	9,000	5,805
Statistics of Oleomargarine, Oleo Oil, etc., from Sixteenth Annual Report, 1899	6,000	6,000
Report upon Experimental Exports of Butter, 1898-1899, from Sixteenth Annual Report, 1899	12,000	10,963
Report upon Examination of Milk, from Sixteenth Annual Report, 1899	2,000	593
Experiments with Texas Fever, etc., from Sixteenth Annual Report, 1899	2,000	311
Foreign Markets for Eggs and Poultry, from Sixteenth Annual Report, 1899	2,000	634
Notes on Parasites, 50-52, from Sixteenth Annual Report, 1899	1,000	1,000
Notes on the Animal Industry of Porto Rico, from Sixteenth Annual Report, 1899	1,000	556
Seventh International Veterinary Congress, from Sixteenth Annual Report, 1899	1,000	1,000
Note on Chicken Tick, from Sixteenth Annual Report, 1899	1,000	1,000
Our Present Knowledge of the Kidney Worm, from Sixteenth Annual Report, 1899	1,000	662
The Nature, Cause, and Economic Importance of Ovine-Caseous Lymphadenitis, from Sixteenth Annual Report, 1899	1,000	278
DIVISION OF BIOLOGICAL SURVEY.		
Bulletin No. 12	1,500	1,297
Bulletin No. 13	4,000	4,000
Bulletin No. 14	5,000	3,826

Publications other than Farmers' Bulletins received and distributed from July 1, 1900, to June 30, 1901—Continued.

Publication.	Received.	Distributed.
DIVISION OF BIOLOGICAL SURVEY—continued.		
Circular No. 28.....	6,000	2,957
Circular No. 29.....	6,000	6,000
Circular No. 30.....	2,000	2,000
Circular No. 31.....	15,000	13,897
Circular No. 32.....	5,000	952
Circular No. 33.....	4,000	2,608
North American Fauna No. 16.....	1,500	1,416
North American Fauna No. 18.....	3,000	2,548
North American Fauna No. 19.....	3,000	3,000
Birds of the Yukon Region, etc., from North American Fauna No. 19.....	150	150
Report of the Acting Chief of Biological Survey, 1900.....	300	300
DIVISION OF BOTANY.		
Bulletin No. 22.....	2,000	1,569
Bulletin No. 25.....	3,000	2,390
Bulletin No. 26.....	6,000	5,842
Circular No. 18.....	46,500	48,589
Circular No. 20.....	3,000	2,323
Circular No. 27.....	2,000	1,889
Circular No. 28.....	8,000	3,107
Circular No. 29.....	5,000	4,284
Circular No. 30.....	4,000	2,354
U. S. National Herbarium, Vol. V, No. 5.....	5,000	4,958
U. S. National Herbarium, Vol. VII, No. 1.....	1,000	972
Report of Botanist for 1900.....	200	182
Circular No. 1, Section of Seed and Plant Introduction.....	3,000	3,000
Circular No. 2, Section of Seed and Plant Introduction.....	2,500	2,026
Inventory No. 7, Section of Seed and Plant Introduction.....	1,500	1,053
Inventory No. 8, Section of Seed and Plant Introduction.....	2,000	1,404
DIVISION OF CHEMISTRY.		
Bulletin No. 57.....	500	217
Bulletin No. 58.....	3,000	3,000
Bulletin No. 59.....	2,000	1,239
Bulletin No. 60.....	3,000	2,677
Bulletin No. 61.....	4,000	2,851
Bulletin No. 62.....	1,000	872
Circular No. 3.....	1,000	1,000
Circular No. 6.....	5,000	5,000
Circular No. 7.....	150	150
Progress of Sugar Beet Industry in the United States in 1899, etc.....	8,000	4,268
Report of the Chemist for 1900.....	500	207
Rapport sur l'usage et les Possibilités de l'Extension du Maïs (Blé d'Inde) en Europe.....	5,000	5,000
DIVISION OF ENTOMOLOGY.		
Bulletin No. 25 (old series, reprint).....	1,000	295
Bulletin No. 1 (new series, reprint).....	1,000	1,000
Bulletin No. 24 (new series).....	2,000	1,857
Bulletin No. 25 (new series).....	4,500	4,500
Bulletin No. 26 (new series).....	2,840	2,703
Observations on Diabrotica, from Bulletin No. 26.....	100	100
Notes on Coccidæ of Georgia, from Bulletin No. 26.....	100	100
Insects of the Year in Ohio, from Bulletin No. 26.....	100	100
Bulletin No. 27 (new series).....	1,000	794
Circular No. 5 (second series).....	2,500	733
Circular No. 10 (second series).....	2,500	822
Circular No. 13 (second series).....	3,500	1,220
Circular No. 16 (second series).....	1,000	531
Circular No. 21 (second series).....	2,500	618
Circular No. 22 (second series).....	2,500	2,500
Circular No. 34 (second series).....	3,000	1,123
Circular No. 40 (second series).....	3,500	1,623
Circular No. 41 (second series).....	5,500	1,732
Circular No. 42 (second series).....	5,000	2,986
Circular No. 43 (second series).....	3,000	1,435
Bibliography of the More Important Contributions to American Economic Entomology, Part VII.....	1,000	952
Report of the Entomologist for 1900.....	500	210
Objects of the Association of Economic Entomologists, from Bulletin No. 26.....	150	150
OFFICE OF EXPERIMENT STATIONS.		
Bulletin No. 21.....	500	695
Bulletin No. 45 (revised).....	500	431
Bulletin No. 69 (revised).....	1,000	455
Bulletin No. 76.....	500	279

Publications other than Farmers' Bulletins received and distributed from July 1, 1900, to June 30, 1901—Continued.

Publication.	Received.	Distrib- uted.
OFFICE OF EXPERIMENT STATIONS—continued.		
Bulletin No. 80 (reprint).....	1,130	70
Bulletin No. 82 (reprint).....	1,000	1,279
Bulletin No. 83.....	2,010	1,934
Bulletin No. 83.....	2,000	1,827
Bulletin No. 84.....	4,100	2,465
Bulletin No. 85.....	4,050	2,433
Bulletin No. 86.....	1,000	1,000
Bulletin No. 86, Part I (reprint).....	5,000	1,208
Bulletin No. 86, Part II (reprint).....	5,000	1,119
Bulletin No. 86, Part III (reprint).....	5,025	1,117
Bulletin No. 87.....	6,000	5,472
Bulletin No. 88.....	3,500	2,096
Bulletin No. 89.....	4,000	3,475
Bulletin No. 90.....	3,000	2,678
Bulletin No. 91.....	3,000	2,624
Bulletin No. 92.....	4,000	3,475
Bulletin No. 93.....	3,000	3,000
Bulletin No. 94.....	2,000	1,907
Bulletin No. 95.....	2,000	1,994
Bulletin No. 96.....	2,000	1,500
Bulletin No. 97.....	3,000	2,840
Circular No. 28.....	3,000	2,087
Circular No. 39.....	300	300
Circular No. 40.....	2,000	249
Circular No. 44.....	2,000	1,042
Circular No. 45.....	3,000	1,954
Circular No. 46.....	3,000	1,575
Record, Vol. XI, No. 11.....	4,800	4,549
Record, Vol. XI, No. 12.....	4,500	3,533
Record, Vol. XII, No. 1.....	4,560	4,379
Record, Vol. XII, No. 2.....	5,000	4,395
Record, Vol. XII, No. 3.....	5,000	4,252
Record, Vol. XII, No. 4.....	5,000	4,248
Record, Vol. XII, No. 5.....	5,230	4,057
Record, Vol. XII, No. 6.....	5,000	4,668
Record, Vol. XII, No. 7.....	5,000	4,705
Record, Vol. XII, No. 8.....	5,000	4,711
Record, Vol. XII, No. 9.....	5,000	4,600
Record, Vol. XII, No. 10.....	5,000	4,320
Report of the Director for 1900.....	3,000	1,866
SECTION OF FOREIGN MARKETS.		
Bulletin No. 9.....	5,000	4,993
Bulletin No. 20.....	6,000	5,716
Bulletin No. 21.....	6,000	5,783
Bulletin No. 23.....	6,100	5,647
Circular No. 23.....	34,000	30,856
Report of Chief for 1900.....	5,000	3,542
DIVISION OF FORESTRY.		
Bulletin No. 22 (reprint).....	1,030	637
Bulletin No. 24.....	20,000	17,999
Bulletin No. 28.....	6,500	5,269
Bulletin No. 29.....	10,000	7,920
Bulletin No. 30.....	10,320	4,471
Circular No. 12.....	2,000	571
Circular No. 21.....	2,000	1,176
Circular No. 22.....	22,000	16,823
Report of Forester for 1900.....	8,000	4,897
LIBRARY.		
Bulletin No. 32.....	1,000	673
Bulletin No. 33.....	1,000	878
Bulletin No. 34.....	1,000	485
Bulletin No. 35.....	750	750
Report of Librarian for 1900.....	200	176
DIVISION OF PUBLICATIONS.		
Bulletin No. 5.....	1,140	1,046
Monthly List of Publications for June, 1900.....	50,000	47,687
Monthly List of Publications for July, 1900.....	55,000	33,332
Monthly List of Publications for August, 1900.....	55,000	51,212
Monthly List of Publications for September, 1900.....	55,000	51,272
Monthly List of Publications for October, 1900.....	49,000	47,687
Monthly List of Publications for November, 1900.....	55,000	45,135
Monthly List of Publications for December, 1900.....	55,000	51,045

Publications other than Farmers' Bulletins received and distributed from July 1, 1900, to June 30, 1901—Continued.

Publication,	Received.	Distrib- uted.
DIVISION OF PUBLICATIONS—continued.		
Monthly List of Publications for January, 1901	55,000	48,896
Monthly List of Publications for February, 1901	55,000	48,462
Monthly List of Publications for March, 1901	55,000	51,885
Monthly List of Publications for April, 1901	57,000	50,461
Monthly List of Publications for May, 1901	58,000	50,464
Publications for Sale by Superintendent of Documents, No. 179, seventh edition	34,217	42,858
Publications Available for Free Distribution, No. 247, sixth edition	15,000	29,998
Report of Chief for 1900	2,000	1,153
DIVISION OF POMOLOGY.		
Report of the Acting Pomologist for 1900	200	200
DIVISION OF EXPERIMENTAL GARDENS AND GROUNDS.		
Report on the Gardens and Grounds for 1900	1,000	203
OFFICE OF PUBLIC ROAD INQUIRIES.		
Bulletin No. 8	2,500	1,088
Bulletin No. 9	1,500	671
Bulletin No. 12	1,500	919
Bulletin No. 17	5,000	1,241
Report of the Director for 1900	1,000	984
OFFICE OF THE SECRETARY.		
Preliminary Report of the Secretary, 1900	12,810	8,456
Agricultural Resources and Capabilities of Porto Rico (House Doc. No. 171)	2,000	1,546
Report of the Assistant Secretary for 1900	200	175
Circular No. 8 (revised)	5,000	3,087
Circular No. 9	3,500	2,533
Reprint from Report 49	5,000	5,000
Report 58	1,000	232
Report 59	1,000	101
Report 66	5,500	5,097
Report 64	10,000	7,523
Report 67	10,100	6,834
Report 68	3,000	1,880
Yearbook of the Department for 1900	30,000	16,535
Annual Reports of the Department of Agriculture for 1900	3,050	3,000
DIVISION OF SOILS.		
Bulletin No. 17	2,000	946
Circular No. 7	500	500
Report of the Chief for 1900	8,000	6,610
Soil Survey in the Connecticut Valley, from Report 64	1,500	1,500
Soil Survey in Salt Lake Valley, from Report 64	5,000	5,000
Some Necessary Modifications in Methods of Mechanical Analysis as Applied to Alkali Soil, from Report 64	300	300
Application of the Theory of Solution to the Study of Soils, from Report 64	300	300
Salts as Influencing the Rate of Evaporation of Water from Soils, from Report 64	250	250
DIVISION OF STATISTICS.		
Bulletin No. 18	30,500	17,774
Bulletin No. 19	7,000	5,242
Circular No. 12	8,000	6,179
Circular No. 13	10,000	10,000
Circular No. 14	6,000	4,508
Crop Reporter:		
Vol. II, No. 3	63,000	57,499
Vol. II, No. 4	231,200	231,200
Vol. II, No. 4 (supplement)	7,000	6,304
Vol. II, No. 5	225,000	224,185
Vol. II, No. 6	220,400	208,573
Vol. II, No. 7	91,400	82,721
Vol. II, No. 8	85,000	83,635
Vol. II, No. 9	95,000	84,170
Vol. II, No. 10	92,000	84,178
Vol. II, No. 11	92,000	84,237
Vol. II, No. 12	88,000	88,000
Vol. III, No. 1	95,000	83,626
Vol. III, No. 2	85,000	83,384

Publications other than Farmers' Bulletins received and distributed from July 1, 1900, to June 30, 1901—Continued.

Publication.	Received.	Distrib- uted.
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.		
Bulletin No. 20	10,868	9,085
Bulletin No. 21	5,000	2,240
Bulletin No. 22	2,500	1,793
Bulletin No. 23	2,500	2,500
Bulletin No. 24	3,375	1,417
Bulletin No. 25	2,000	1,782
Bulletin No. 26	2,750	2,377
Bulletin No. 27	4,000	2,676
Report of the Chief for 1900	600	213
EXTRACTS FROM YEARBOOKS.		
Mineral Phosphate as Fertilizers, from Yearbook for 1894	500	525
Hawks and Owls from Standpoint of the Farmer, from Yearbook for 1894	5,000	1,201
Grasses as Sand and Soil Binders, from Yearbook for 1894	2,000	441
The Cause and Prevention of Pear Blight, from Yearbook for 1895	5,000	860
Pruning and Training of Grapes, from Yearbook for 1896	5,000	1,348
Every Farm an Experiment Station, from Yearbook for 1897	1,000	302
Utilizing Surplus Fruits, from Yearbook for 1898	1,000	401
The Present Condition of Grape Culture in California, from Yearbook for 1898	500	141
Steel-Track Wagon Roads, from Yearbook for 1898	1,000	569
Construction of Good Country Roads, from Yearbook for 1898	1,000	702
The Movement and Retention of Water in Soils, from Yearbook for 1898	1,000	336
The Soluble Mineral Matter of Soils, from Yearbook for 1898	1,000	241
Some Examples of the Development of Knowledge Concerning Animal Diseases, from Yearbook for 1899	500	239
Administrative Work of the Federal Government in Relation to the Animal Industry, from Yearbook for 1899	500	194
Dairy Development in the United States, from Yearbook for 1899	8,025	7,090
Development of the Nutrition Investigations of the Department of Agri- culture, from Yearbook for 1899	1,000	383
Soil Investigation in the United States, from Yearbook for 1899	2,000	372
Agricultural Education in the United States, from Yearbook for 1899	1,000	344
Progress in Economic Entomology in the United States, from Yearbook for 1899	1,000	353
Progress of Road Building in the United States, from Yearbook for 1899	3,000	1,653
Development of Transportation in the United States, from Yearbook for 1899	100	84
Work of the Breeder in Improving Live Stock, from Yearbook for 1899	100	100
Agricultural Experiment Stations in the United States, from Yearbook for 1899	2,000	217
Progress of Economic and Scientific Agrostology, from Yearbook for 1899	2,000	1,305
A Review of Economic Ornithology in the United States, from Yearbook for 1899	3,000	2,364
Development of Agricultural Libraries, from Yearbook for 1899	500	361
Progress of Agriculture in the United States, from Yearbook for 1899	3,000	2,766
The Relation of Chemistry to the Progress of Agriculture, from Year- book for 1899	3,000	528
Rise and Future of Irrigation in the United States, from Yearbook for 1899	1,000	959
Progress of Plant Breeding in the United States, from Yearbook for 1899	3,000	1,460
Work of the Meteorologist for the Benefit of Agriculture, Commerce, and Navigation, from Yearbook for 1899	2,000	2,000
Seed Selling, Seed Growing, and Seed Testing, from Yearbook for 1899	2,000	628
A Directory for Farmers, from Yearbook for 1899	3,800	2,441
Progress of Forestry in the United States, from Yearbook for 1899	15,000	4,220
The Practice of Forestry by Private Owners, from Yearbook for 1899	15,000	5,312
Growth of the Tobacco Industry, from Yearbook for 1899	5,000	131
Progress in the Treatment of Plant Diseases in the United States, from Yearbook for 1899	3,000	2,070
Succulent Forage for Farm and Dairy, from Yearbook for 1899	3,000	1,535
Progress of Commercial Growing of Plants Under Glass, from Yearbook for 1899	6,000	5,106
Rabies: Its Cause, Frequency, and Treatment, from Yearbook for 1900	2,000	1,520
Agricultural Education in France, from Yearbook for 1900	1,000	25
A Directory for Farmers, from Yearbook for 1900	2,000	1
Total	3,117,368	3,068,918

Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1900-1901.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
16	Leguminous Plants for Green Manuring and for Feeding	35,000	17,683	6,700
17	Peach Yellow and Peach Rosette	20,000		
19	Important Insecticides: Directions for Their Preparation and Use		4,600	1,647
20	Washed Soils: How to Prevent and Reclaim Them		13,490	6,180
21	Barnyard Manure	50,200	1,000	1,460
22	Feeding Farm Animals	40,800	25,755	7,819
23	Foods: Nutritive Value and Cost	30,000	35,014	8,000
24	Hog Cholera and Swine Plague	30,000	23,779	11,162
25	Peanuts: Culture and Uses	45,300	38,744	6,887
26	Sweet Potatoes: Culture and Uses		10,199	5,399
27	Flax for Seed and Fiber	30,200	19,154	5,943
28	Weeds, and How to Kill Them	20,000	5,566	2,571
29	Souring of Milk, and Other Changes in Milk Products	30,000	29,047	10,405
30	Grape Diseases on the Pacific Coast	10,000	16,301	7,099
31	Alfalfa, or Lucern	20,000	3,610	2,468
32	Silos and Silage	20,000	18,368	7,534
33	Peach Growing for Market	20,000	15,206	6,334
34	Meats: Composition and Cooking	30,000	21,158	6,785
35	Potato Culture	15,000	18,983	8,087
36	Cotton Seed and its Products	55,000	34,416	9,429
37	Kafir Corn: Characteristics, Culture, and Uses	30,000	12,853	3,452
38	Spraying for Fruit Diseases	20,000	13,269	6,136
39	Onion Culture	20,000	26,831	9,083
40	Farm Drainage	47,000	15,619	5,618
41	Fowls: Care and Feeding	45,000	27,296	6,233
42	Facts About Milk	75,900	56,887	14,844
43	Sewage Disposal on the Farm	55,000	28,195	7,818
44	Commercial Fertilizers		7,577	4,242
45	Some Insects Injurious to Stored Grain	20,500	19,087	8,827
46	Irrigation in Humid Climates	10,000	18,590	4,342
47	Insects Affecting the Cotton Plant	20,000	4,402	3,091
48	The Manuring of Cotton	10,000	14,996	2,944
49	Sheep Feeding	55,000	15,978	2,588
50	Sorghum as a Forage Crop	20,000	26,440	6,303
51	Standard Varieties of Chickens	45,000	18,423	4,909
52	The Sugar Beet	46,800	49,209	15,531
53	How to Grow Mushrooms		17,569	4,232
54	Some Common Birds in Their Relation to Agriculture		12,187	8,509
55	The Dairy Herd: Its Formation and Management	20,000	26,532	8,685
56	Experiment Station Work—I	45,000	33,320	9,323
57	Butter Making on the Farm	15,000	13,171	5,009
58	The Soy Bean as a Forage Crop	55,000	30,833	7,897
59	Bee Keeping	10,000	10,172	4,992
60	Methods of Curing Tobacco	15,000	23,150	10,162
61	Asparagus Culture		12,044	3,463
62	Marketing Farm Produce	40,200	16,317	8,573
63	Care of Milk on the Farm	30,600	22,154	6,617
64	Ducks and Geese	45,000	28,884	7,250
65	Experiment Station Work—II	25,760	31,454	8,477
66	Meadows and Pastures	15,000	13,300	4,569
67	Forestry for Farmers	30,000	22,428	5,710
68	The Black Rot of the Cabbage	30,000	15,741	5,636
69	Experiment Station Work—III		13,018	4,272
70	The Principal Insect Enemies of the Grape	30,000	10,926	4,481
71	Some Essentials in Beef Production	15,100	11,321	4,627
72	Cattle Ranges of the Southwest	45,000	23,035	5,639
73	Experiment Station Work—IV		6,821	3,465
74	Milk as Food	10,200	12,296	4,443
75	The Grain Smuts	30,120	19,831	7,687
76	Tomato Growing	30,000	15,583	4,707
77	The Liming of Soils	45,000	24,928	9,210
78	Experiment Station Work—V	15,200	13,974	5,559
79	Experiment Station Work—VI	15,000	9,385	4,410
80	The Peach Twig-borer—an Important Enemy of Stone Fruits	15,000	8,175	3,840
81	Corn Culture in the South	35,000	14,820	4,894
82	The Culture of Tobacco	30,000	20,815	4,813
83	Tobacco Soils		14,514	3,937
84	Experiment Station Work—VII		17,692	2,942
85	Fish as Food	15,000	10,138	4,952
86	Thirty Poisonous Plants	30,000	13,137	7,089
87	Experiment Station Work—VIII	30,000	18,137	7,842
88	Alkali Lands	10,000	9,336	4,477
89	Cowpeas		4,926	2,478
90	The Manufacture of Sorghum Sirup	30,000	21,234	6,758
91	Potato Diseases and Their Treatment	25,000	18,661	4,264
92	Experiment Station Work—IX	41,180	35,042	8,863
		15,300	13,039	4,483

Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1900-1901—Continued.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
93	Sugar as Food.....		10,803	6,553
94	The Vegetable Garden.....	60,000	48,705	11,627
95	Good Roads for Farmers.....	100,660	81,141	7,877
96	Raising Sheep for Mutton.....	30,471	33,710	7,855
97	Experiment Station Work—X.....		10,613	4,440
98	Suggestions to Southern Farmers.....		19,182	3,806
99	Three Insect Enemies of Shade Trees.....	35,000	18,450	4,433
100	Hog Raising in the South.....	15,360	28,557	4,466
101	Millet.....	15,000	13,725	4,266
102	Southern Forage Plants.....	25,000	15,698	3,916
103	Experiment Station Work—XI.....	15,300	12,018	4,635
104	Notes on Frost.....	45,000	14,828	6,501
105	Experiment Station Work—XII.....	15,000	9,824	5,286
106	Breeds of Dairy Cattle.....	110,000	61,920	11,601
107	Experiment Station Work—XIII.....	15,000	15,229	6,846
108	Saltbushes.....		4,569	2,711
109	Farmers' Reading Courses.....	80,200	34,140	17,718
110	Rice Culture in the United States.....	10,000	5,322	2,940
111	The Farmer's Interest in Good Seed.....	35,300	29,456	6,009
112	Bread and Bread Making.....	50,280	30,556	10,290
113	The Apple and How to Grow It.....	90,600	62,971	13,214
114	Experiment Station Work—XIV.....	20,100	14,630	6,368
115	Hop Culture in California.....		2,281	7,662
116	Irrigation in Fruit Growing.....	30,200	13,361	10,777
117	Sheep, Hogs, and Horses in the Northwest.....	60,000	30,524	11,143
118	Grape Growing in the South.....	60,000	22,242	9,966
119	Experiment Station Work—XV.....	50,000	18,514	16,987
120	The Principal Insects Affecting the Tobacco Plant.....	30,150	7,435	7,624
121	Beans, Peas, and other Legumes as Food.....	90,000	34,036	16,943
122	Experiment Station Work—XVI.....	60,000	12,490	10,104
123	Red Clover Seed.....	30,000	13,372	9,230
124	Experiment Station Work—XVII.....	30,000	8,017	10,670
125	Protection of Food Products from Injurious Temperatures.....	20,800	4,545	12,739
126	Practical Suggestions for Farm Buildings.....	50,000	19,138	17,750
127	Important Insecticides.....	30,000	3,931	15,334
128	Eggs and Their Uses as Food.....	30,000	3,657	10,971
129	Sweet Potatoes.....	30,000	4,116	8,018
130	The Mexican Cotton Boll Weevil.....	30,000	251	9,683
131	Household Tests for Detection of Oleomargarine and Renovated Butter.....	30,000	136	5,020
132	The Principal Insect Enemies of Growing Wheat.....	15,100	2,872	12,228
Total.....		3,359,881	2,195,010	821,343

Publications received and distributed by the Weather Bureau during the year ended June 30, 1901, by quarters.

Number and title of publication.	Number of copies.
QUARTER ENDED SEPTEMBER 30, 1900.	
<i>Received.</i>	
No. 221. Bulletin G. Atmospheric Radiation: A Research Conducted at the Allegheny Observatory and at Providence, R. I.....	2,000
No. 224. Monthly Weather Review for May, 1900.....	4,450
No. 225. Monthly Weather Review for June, 1900.....	4,450
No. 226. Monthly Weather Review for July, 1900.....	4,450
Report of the Chief of the Weather Bureau, 1898-99, Part II.....	50
Report of the Chief of the Weather Bureau, 1898-99, Part III.....	500
Report of the Chief of the Weather Bureau, 1898-99, Part IV.....	100
Report of the Chief of the Weather Bureau, 1898-99, Part V.....	100
Work of the Meteorologist for the Benefit of Agriculture, Commerce, and Navigation, Bound Washington Daily Weather Maps, July 1, 1897, to December 31, 1897.....	2,000
Washington Daily Weather Maps.....	10
Meteorological Chart of the Great Lakes.....	120,960
Climate and Crop Bulletin.....	9,008
Storm Bulletin No. 1, 1900. West Indian Hurricane of September 1-10, 1900.....	53,173
	425
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1891-92.....	1
Report of the Chief of the Weather Bureau, 1893.....	2
Report of the Chief of the Weather Bureau, 1894.....	3
Report of the Chief of the Weather Bureau, 1895-96.....	7
Report of the Chief of the Weather Bureau, 1896-97.....	12
Report of the Chief of the Weather Bureau, 1897-98.....	13

Publications received and distributed by the Weather Bureau during the year ended June 30, 1901, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED SEPTEMBER 30, 1900—continued.	
<i>Distributed—Continued.</i>	
Report of the Chief of the Weather Bureau, 1898-99, Vol. 1.....	35
Separates from the Report of the Chief of the Weather Bureau, 1891-92.....	84
Separates from the Report of the Chief of the Weather Bureau, 1894.....	13
Separates from the Report of the Chief of the Weather Bureau for 1895-96.....	4
Separates from the Report of the Chief of the Weather Bureau for 1896-97.....	18
Separates from the Report of the Chief of the Weather Bureau, 1897-98.....	42
Separates from the Report of the Chief of the Weather Bureau, 1898-99.....	139
Description of Cloud Forms.....	270
Bulletin No. 25.....	15
Bulletin No. 26.....	27
Bulletin No. 28.....	5
Bulletin C.....	7
Bulletin D.....	32
Bulletin E.....	2
No. 199. Property Loss by Lightning.....	24
No. 221. Bulletin G. Atmospheric Radiation: A Research Conducted at the Allegheny Observatory and at Providence, R. I.....	750
No. 219. Frost Fighting.....	250
No. 224. Monthly Weather Review for May, 1900.....	4,400
No. 225. Monthly Weather Review for June, 1900.....	4,400
No. 226. Monthly Weather Review for July, 1900.....	4,000
Work of the Meteorologist for the Benefit of Agriculture, Commerce, and Navigation.....	1,500
Bound Washington Daily Weather Maps, July 1, 1897, to December 31, 1897.....	10
Washington Daily Weather Maps.....	129,960
Meteorological Chart of the Great Lakes.....	9,088
Climate and Crop Bulletin.....	53,173
Storm Bulletin No. 1, 1900. West Indian Hurricane of September 1-10, 1900.....	425
QUARTER ENDED DECEMBER 31, 1900.	
<i>Received.</i>	
No. 227. Daily River Stages at River Gauge Stations on the Principal Rivers of the United States, Part VI, for the years 1896, 1897, 1898, and 1899.....	400
No. 228. Tables of Daily Precipitation for the years 1893, 1894, 1895.....	800
No. 229. Monthly Weather Review for August, 1900.....	4,450
No. 230. Monthly Weather Review for September, 1900.....	4,450
No. 231. Report of the Chief of the Weather Bureau for 1900.....	1,000
No. 232. Bulletin H. West Indian Hurricanes.....	2,000
No. 233. Circular D. Instrument Division. Anemometry. Second edition.....	1,500
No. 234. Monthly Weather Review for October, 1900.....	4,450
Washington Daily Weather Maps.....	137,742
Meteorological Charts of the Great Lakes.....	6,104
Climate and Crop Bulletin.....	13,258
Bound Monthly Weather Reviews for the year 1899.....	200
Snow and Ice Bulletin.....	6,600
Report of the Chief of the Weather Bureau for 1898-99, Vol. II.....	1,000
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1891-92.....	6
Report of the Chief of the Weather Bureau, 1893.....	4
Report of the Chief of the Weather Bureau, 1894.....	4
Report of the Chief of the Weather Bureau, 1895-96.....	7
Report of the Chief of the Weather Bureau, 1896-97.....	5
Report of the Chief of the Weather Bureau, 1897-98.....	4
Report of the Chief of the Weather Bureau, 1898-99, Vol. 1.....	134
Report of the Chief of the Weather Bureau, 1898-99, Vol. 2.....	840
Separates from Report of the Chief of the Weather Bureau, 1891-92.....	30
Separates from the Report of the Chief of the Weather Bureau, 1894.....	11
Separates from Report of the Chief of the Weather Bureau for 1895-96.....	13
Separates from Report of the Chief of the Weather Bureau for 1896-97.....	23
Separates from Report of the Chief of the Weather Bureau for 1897-98.....	26
Separates from Report of the Chief of the Weather Bureau for 1898-99.....	45
Description of Cloud Forms.....	304
Bulletin A.....	1
Bulletin C.....	3
Bulletin D.....	15
Bulletin E.....	4
Bulletin No. 22.....	7
Bulletin No. 23.....	8
Bulletin No. 25.....	22
Bulletin No. 26.....	22
Bulletin No. 28.....	12
Bulletin No. 29.....	12
No. 199. Property Loss by Lightning.....	15
No. 220. Bulletin F. Report on Kite Observations, 1898.....	7

Publications received and distributed by the Weather Bureau during the year ended June 30, 1901, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED DECEMBER 31, 1900—continued.	
<i>Distributed—Continued.</i>	
No. 221. Bulletin G. Atmospheric Radiation: A Research Conducted at the Allegheny Observatory and at Providence, R. I.	610
No. 227. Daily River Stages at River Gauge Stations on the Principal Rivers of the United States, Part VI, 1896, 1897, 1898, and 1899	360
No. 228. Tables of Daily Precipitation for the years 1893, 1894, and 1895	728
No. 229. Monthly Weather Review for August, 1900	4,400
No. 230. Monthly Weather Review for September, 1900	4,400
No. 231. Report of the Chief of the Weather Bureau for 1900	700
No. 232. Bulletin H. West Indian Hurricanes	1,300
No. 233. Circular D. Instrument Division. Anemometry. Second edition	1,500
No. 234. Monthly Weather Review for October, 1900	4,400
Washington Daily Weather Maps	137,742
Meteorological Charts of the Great Lakes	6,104
Climate and Crop Bulletin	13,258
Snow and Ice Bulletin	6,600
Bound Monthly Weather Reviews for 1899	200
QUARTER ENDED MARCH 31, 1901.	
<i>Received.</i>	
No. 235. Psychrometric Tables for Obtaining the Vapor Pressures, Relative Humidity, and Temperature of the Dew-Point	5,000
No. 236. Monthly Weather Review for November, 1900	4,450
No. 237. Meteorological Chart of the Great Lakes. Summary for the Season of 1900. Volume III, No. 10	2,500
No. 238. Monthly Weather Review for December, 1900	4,450
No. 239. Monthly Weather Review. Annual Summary for 1900	4,500
No. 240. Monthly Weather Review for January, 1901	4,500
Washington Daily Weather Maps	138,046
Climate and Crop Bulletin	14,463
Snow and Ice Bulletin	22,404
Washington Daily Weather Maps bound from January 1, 1898, to June 30, 1898	11
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1891-92	5
Report of the Chief of the Weather Bureau, 1893	6
Report of the Chief of the Weather Bureau, 1894	5
Report of the Chief of the Weather Bureau, 1895-96	6
Report of the Chief of the Weather Bureau, 1896-97	5
Report of the Chief of the Weather Bureau, 1897-98	3
Report of the Chief of the Weather Bureau, 1898-99, Vol. I	8
Report of the Chief of the Weather Bureau, 1898-99, Vol. II	22
Separates from the Report of the Chief of the Weather Bureau, 1891-92	72
Separates from the Report of the Chief of the Weather Bureau for 1893	5
Separates from the Report of the Chief of the Weather Bureau for 1894	9
Separates from the Report of the Chief of the Weather Bureau for 1895-96	36
Separates from the Report of the Chief of the Weather Bureau for 1896-97	46
Separates from the Report of the Chief of the Weather Bureau for 1897-98	72
Separates from the Report of the Chief of the Weather Bureau for 1898-99	21
Description of Cloud Forms. Fourth edition	131
Certain Climatic Features of the Two Dakotas	105
Bulletin A	1
Bulletin C	7
Bulletin D	35
Bulletin E	5
Bulletin F	763
Bulletin G	34
Bulletin H	84
Bulletin No. 11, Part III	5
Bulletin No. 14	6
Bulletin No. 16	7
Bulletin No. 19	8
Bulletin No. 22	9
Bulletin No. 23	11
Bulletin No. 25	45
Bulletin No. 26	40
Bulletin No. 28	8
No. 199. Property Loss by Lightning	9
No. 227. Daily River Stages at River Gauge Stations on the Principal Rivers of the United States, Parts V and VI (four of each part)	8
No. 235. Psychrometric Tables for Obtaining the Vapor Pressures, Relative Humidity, and Temperature of the Dew-Point	5,000
No. 236. Monthly Weather Review for November, 1900	4,400
No. 237. Meteorological Chart of the Great Lakes. Summary for 1900, Vol. III, No. 10	2,500
No. 238. Monthly Weather Review for December, 1900	4,400
No. 239. Monthly Weather Review. Annual Summary for 1900	4,450
No. 240. Monthly Weather Review for January, 1900	4,450
Washington Daily Weather Maps	138,046

Publications received and distributed by the Weather Bureau during the year ended June 30, 1901, by quarters—Continued.

Number and title of publication.	Number of copies.
QUARTER ENDED MARCH 31, 1901—continued.	
<i>Distributed—Continued.</i>	
Climate and Crop Bulletins	14,463
Snow and Ice Chart	22,404
Washington Daily Weather Maps (bound), from January 1, 1898, to June 30, 1898.....	11
QUARTER ENDED JUNE 30, 1901.	
<i>Received.</i>	
No. 241. Circular F, Instrument Division. Second edition. Barometers and the Measurement of Atmospheric Pressure.....	1,500
No. 242. Monthly Weather Review for February, 1901.....	4,500
No. 243. Monthly Weather Review for March, 1901.....	4,500
No. 244. Meteorological Chart of the Great Lakes, No. 1, 1901.....	3,000
No. 245. Monthly Weather Review for April, 1901.....	4,500
Report of the Chief of the Weather Bureau, 1899-1900.....	1,000
Report of the Chief of the Weather Bureau, 1899-1900, Part II, List of Observing Stations and Changes Therein during 1899.....	50
Report of the Chief of the Weather Bureau, 1899-1900, Part III, Monthly and Annual Meteorological Summaries.....	500
Report of the Chief of the Weather Bureau, 1899-1900, Part IV, Monthly and Annual Mean Temperature and Annual Extremes of Temperatures, together with the dates of first and last killing frost, 1899.....	200
Report of the Chief of the Weather Bureau, 1899-1900, Part V, Monthly and Annual Precipitation, 1899. All stations.....	200
Report of the Chief of the Weather Bureau, 1899-1900, Part VI, Miscellaneous Meteorological Tables and Reports.....	250
Report of the Chief of the Weather Bureau, 1899-1900, Part VII, Meteorological Observations of the Second Wellman Expedition.....	500
Washington Daily Weather Maps (bound), from July 1, 1898, to December 31, 1898, inclusive.....	11
Washington Daily Weather Maps (bound), January 1, 1899, to June 30, 1899, inclusive.....	11
Washington Daily Weather Maps.....	142,050
Climate and Crop Bulletin.....	55,476
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1891-92.....	6
Report of the Chief of the Weather Bureau, 1893.....	7
Report of the Chief of the Weather Bureau, 1894.....	10
Report of the Chief of the Weather Bureau, 1895-96.....	7
Report of the Chief of the Weather Bureau, 1896-97.....	6
Report of the Chief of the Weather Bureau, 1897-98.....	6
Report of the Chief of the Weather Bureau, 1898-99, Vol. I.....	7
Report of the Chief of the Weather Bureau, 1898-99, Vol. II.....	10
Report of the Chief of the Weather Bureau, 1899-1900.....	985
Separates from the Report of the Chief of the Weather Bureau, 1891-92.....	31
Separates from the Report of the Chief of the Weather Bureau, 1894.....	5
Separates from the Report of the Chief of the Weather Bureau, 1895-96.....	7
Separates from the Report of the Chief of the Weather Bureau, 1896-97.....	15
Separates from the Report of the Chief of the Weather Bureau, 1897-98.....	31
Separates from the Report of the Chief of the Weather Bureau, 1898-99.....	6
Separates from the Report of the Chief of the Weather Bureau for 1899-1900.....	679
Bulletin No. 11, Part III.....	4
Bulletin No. 14.....	5
Bulletin No. 16.....	6
Bulletin No. 19.....	3
Bulletin No. 22.....	4
Bulletin No. 23.....	5
Bulletin No. 25.....	14
Bulletin No. 26.....	25
Bulletin No. 28.....	5
Bulletin D.....	17
Bulletin E.....	3
Bulletin F.....	6
Bulletin G.....	5
Bulletin H.....	29
No. 199. Property Loss by Lightning.....	11
No. 241. Circular F, Instrument Division. Second edition. Barometers and the Measurement of Atmospheric Pressure.....	1,500
No. 242. Monthly Weather Review for February, 1901.....	4,450
No. 243. Monthly Weather Review for March, 1901.....	4,450
No. 244. Meteorological Chart of the Great Lakes, No. 1, 1901.....	3,000
No. 245. Monthly Weather Review for April, 1901.....	4,450
Washington Daily Weather Maps (bound), from July 1, 1898, to December 31, 1898, inclusive.....	11
Washington Daily Weather Maps (bound), from January 1, 1899, to June 30, 1899, inclusive.....	11
Washington Daily Weather Maps.....	142,050
Climate and Crop Bulletin.....	55,476
Description of Cloud Forms.....	43

DAILY WEATHER MAPS, METEOROLOGICAL CHARTS, SNOW AND ICE BULLETINS,
AND CLIMATE AND CROP BULLETINS ISSUED BY WEATHER BUREAU.

The following shows the number of copies of Washington Daily Weather Maps, Meteorological Charts of the Great Lakes, Snow and Ice Bulletins, and Climate and Crop Bulletins of the Weather Bureau issued each month from July 1, 1900, to June 30, 1901:

Daily Weather Maps, Meteorological Charts, Snow and Ice Bulletins, and Climate and Crop Bulletins issued by Weather Bureau.

Maps, charts, and bulletins.	Number of copies.
WASHINGTON DAILY WEATHER MAPS.	
Washington Daily Weather Maps, July, 1900.....	36,600
Washington Daily Weather Maps, August, 1900.....	46,520
Washington Daily Weather Maps, September, 1900.....	45,840
Washington Daily Weather Maps, October, 1900.....	47,556
Washington Daily Weather Maps, November, 1900.....	44,418
Washington Daily Weather Maps, December, 1900.....	45,768
Washington Daily Weather Maps, January, 1901.....	46,888
Washington Daily Weather Maps, February, 1901.....	45,320
Washington Daily Weather Maps, March, 1901.....	47,238
Washington Daily Weather Maps, April, 1901.....	48,030
Washington Daily Weather Maps, May, 1901.....	48,080
Washington Daily Weather Maps, June, 1901.....	45,940
Total.....	544,798
METEOROLOGICAL CHARTS OF THE GREAT LAKES.	
Meteorological Charts of the Great Lakes, July, 1900.....	3,029
Meteorological Charts of the Great Lakes, August, 1900.....	3,039
Meteorological Charts of the Great Lakes, September, 1900.....	3,034
Meteorological Charts of the Great Lakes, October, 1900.....	3,025
Meteorological Charts of the Great Lakes, November, 1900.....	3,075
Meteorological Charts of the Great Lakes, December, 1900.....	3,029
Meteorological Charts of the Great Lakes, No. 1, 1901, W. B. No. 24.....	3,000
Total.....	21,231
SNOW AND ICE BULLETINS.	
Snow and Ice Bulletins, December, 1900.....	6,600
Snow and Ice Bulletins, January, 1901.....	8,824
Snow and Ice Bulletins, February, 1901.....	7,200
Snow and Ice Bulletins, March, 1901.....	7,380
Total.....	30,004
CLIMATE AND CROP BULLETINS.	
Climate and Crop Bulletins, July, 1900.....	20,795
Climate and Crop Bulletins, August, 1900.....	16,729
Climate and Crop Bulletins, September, 1900.....	16,649
Climate and Crop Bulletins, October, 1900.....	4,163
Climate and Crop Bulletins, November, 1900.....	4,500
Climate and Crop Bulletins, December, 1900.....	4,595
Climate and Crop Bulletins, January, 1901.....	5,135
Climate and Crop Bulletins, February, 1901.....	4,656
Climate and Crop Bulletins, March, 1901.....	4,672
Climate and Crop Bulletins, April, 1901.....	21,330
Climate and Crop Bulletins, May, 1901.....	17,586
Climate and Crop Bulletins, June, 1901.....	16,560
Total.....	137,370

REPORT OF THE FORESTER.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF FORESTRY,

Washington, D. C., October 10, 1901.

SIR: I have the honor to transmit herewith a report of the work of the Division of Forestry for the fiscal year ended June 30, 1901, together with an outline of the plans for the work of the new Bureau for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

GENERAL PROGRESS.

During the past year the demand for the services of the Division of Forestry has continued steadily to outstrip its resources. In particular, the demand for forest working plans has notably increased, although the gain in acres is less than for the previous year, since the latter included the whole area of the National forest reserves, and no other single application of parallel magnitude is possible.

Beyond the increased demand for the services of the Division, and the increased appreciation of its work in which this demand had its rise, the most notable fact of the year was the advancement of the Division to be a Bureau by the agricultural appropriation bill approved March 2, 1901. The Bureau of Forestry came into existence July 1, 1901.

The Bureau is now called upon to give practical assistance and advice in the management of National, State, and private forests on about 50,000,000 acres, an area larger than that covered by the State of Nebraska. It has become to the people of the United States the recognized source of help in the handling of timber tracts and wood lots, the making of forest plantations, the study of commercial trees, and the investigation of important forest problems. It is occupying more and more fully its natural position as adviser in all forest matters in this country.

During the past year the preparation of the results for publication has been somewhat overshadowed by the urgent demand for field work, to satisfy which must always be the first duty of the Bureau. Provision has, however, been made for the prompt preparation of reports for publication in future, and the large number of manuscripts on hand will be made ready as rapidly as possible.

Satisfactory progress has been made during the year in the further organization of a body of trained men, which was wholly lacking

until recently. The expansion of this force, which has been a matter of great difficulty in the past, will be comparatively easy in the future, since the Bureau may now look for a steady supply of trained men from the forest schools.

The steady growth of public interest in the preservation and wise use of forests during the past year is a subject for congratulation. Not only has the interest in forest management spread among important lumber companies and other holders of forest lands, but the interest in forest preservation has taken firmer hold than ever before of those portions of the country whose prosperity depends upon their water supply. The intimate relation of forests and waters is being realized in the West with a practical force that is altogether new, and it may fairly be expected that from this time on one of the most powerful aids toward forest preservation will be the cooperation of the irrigation farmer.

There has been a marked development of the forest movement in the South during the past year. The growing appreciation of the advantages of practical forestry is here, no less than in the North, largely the direct result of practical assistance from this Division to private owners in handling their forest lands.

Interest in tree planting has revived in the central West to a very marked degree, as a result of the efforts of this Division, and the promise of still wider and happier results is exceptionally bright.

EFFICIENCY AND GROWTH.

It is believed that the practical efficiency of the Division has never been at a higher point than during the past fiscal year, and it may fairly be hoped that with larger resources and more numerous trained men, and with a further development of the *esprit de corps* which was already a marked characteristic of the Division, the Bureau of Forestry will reach that still higher plane whose attainment is a necessary condition to the fulfillment of the possibilities which lie in the immediate future of Government forest work.

The larger work of the Division so far outgrew its old rooms; together with all the additional space it had been able to secure from kindred organizations in the Department of Agriculture, that it was forced to find larger quarters. On May 1 it took possession of the seventh floor of the Atlantic Building, 930 F street, NW. Tentative arrangements have been made for necessary expansion to other floors of the Atlantic Building, since the present quarters are already becoming too small.

It is a gratifying fact that for the calendar year 1900 the average sick leave taken by employees of the Division of Forestry was but 7.4 per cent and of annual leave but 65.9 per cent of the legal allowance.

SECTION OF WORKING PLANS.

PRIVATE LANDS.

The applications from private owners for assistance in handling their forest lands number 38 for the past year. Twenty-one are for timber tracts and 17 for wood lots, the total area covered being 288,555 acres. The total area of private lands to July 1, 1901, for the management of which assistance has been requested since the publication of Circular No. 21, in October, 1898, is 2,804,648 acres. This circular outlines the terms on which farmers, lumbermen, and others

may cooperate with the Bureau in handling their forest lands. Cooperation on these terms was undertaken in order to create practical examples of the conservative management of private forest lands, to show its advantages over ordinary methods, both to the owner and to the forest, and then by publication to spread a knowledge of the work and its results as widely as possible. Areas of 200 acres and under are examined, and methods of handling are advised, entirely without cost to the owner. In the preparation of detailed working plans for larger tracts, the owners were required to pay the traveling and field expenses of the men engaged in the work, amounting to about one-half the cost of the necessary studies on the ground.

Personal examinations were made during the year of 14 timber tracts and 3 wood lots in 11 States, covering 788,890 acres. Five detailed working plans were made. One of these was for 100,000 acres of Shortleaf and Loblolly Pine in Grant, Jefferson, and Saline counties, Ark., the property of the Sawyer and Austin Lumber Company.

The field work necessary to this working plan occupied a party of 6 men for six months. It included the measurement of the stand upon 1,900 acres and of the rate of growth of 625 trees, with a careful study of the forest, the habits of its trees, and the conditions necessary to their successful reproduction. An investigation was made of the effects of fire on the forest and the best means of preventing its recurrence in the future. The effect of present methods of lumbering was studied in order to advise those modifications which, without encroaching too far upon present profits, will hasten the production of a second crop upon the lumbered area. In brief, the field work included a thorough expert examination of the forest and its possibilities to serve as a basis for the best business policy in its management.

The tract of the Sawyer and Austin Lumber Company is generally favorable for practical forestry. It contains an excellent stand of merchantable timber, for which there is a steady market. The logging and transport of timber are not expensive. The reproduction of the pines, and particularly of the Loblolly, can be assured cheaply under effective protection against fire.

Another detailed working plan was made for a tract of 52,000 acres, in Dunklin and Pemiscot counties, Mo., owned by the Deering Harvester Company. This forest, situated in the moist and fertile valley of the Mississippi, contains valuable hardwoods, particularly oak, ash, and hickory, in mixture with trees of little or no commercial importance. In addition to the good opportunity which it offers for conservative forest management on a sound financial basis, this tract presents at least one exceedingly interesting and important silvicultural problem, namely, to foster, by cutting, the reproduction of the valuable hardwoods against that of the trees of little commercial value with which they occur in mixture.

A third large tract for which a working plan was made during the fiscal year was one of 1,600 acres near Lenox, Mass., the property of Hon. William C. Whitney. It is a second-growth hardwood forest from 15 to 40 years old, from which the first growth has been entirely removed. The problem here was to improve the quality of the future mature stand by the removal of worthless kinds and of stunted, unpromising, and malformed trees. It has been found that these cuttings pay, and they will consequently be continued throughout this forest.

A fourth working plan was completed for 60,000 acres of spruce,

pine, and hardwood in the northern Adirondacks, the property of Mr. William G. Rockefeller. The area is notable as containing one of the most valuable bodies of White Pine in New York.

In addition to those completed, the preparation of working plans was begun upon five timber tracts with a total area of 628,000 acres. One of these, 80,000 acres in extent, lies in the Great Smoky Mountains of eastern Tennessee, a region which offers a wide field for practical forestry and in which the Bureau is doing its first work on a large scale in that State. The field work done on this tract included a careful study of the more important hardwoods, particularly of the White Oak and Yellow Poplar.

A tract of 350,000 acres in Maine, owned by the Great Northern Paper Company, is the largest area of private ownership for which the Division has definitely undertaken a working plan and in several ways one of the most promising. The larger portion of the tract is on the Penobscot River near Moosehead and Chesuncook lakes. The country contains a network of lakes and ponds surrounded by low hills, between which are long stretches of fairly level land. It is in consequence admirably adapted to the cheap logging and transport of soft-wood timber. The forest is composed chiefly of spruce and fir, with a varying mixture of hardwoods. The object of the owners is so to lumber the tract as to insure a sustained supply of soft-wood timber for their mill.

It is a noteworthy fact that, before applying for a working plan for its land, the Great Northern Paper Company had already shown its appreciation of the advantages of conservative forest management by incorporating in its logging contracts several of the more important rules which govern lumbering now carried on under the supervision of the Bureau of Forestry in the Adirondacks. It is believed that the voluntary adoption of these rules by a paper company is the strongest argument in their favor yet made.

In the Adirondacks there are now four tracts to which practical forestry is applied under the direction of the Bureau. One tract of 10,000 acres was added during the year, and the total area under management in that region is now 156,470 acres. An important experiment in thinning second-growth hardwoods has been undertaken on the 14,000 acres of hardwood land in Massachusetts to which reference has been made, in order to test the opportunity to make a profit and improve the stand. The results, coupled with the study of the rate of growth of New England hardwoods now in progress, will be of direct value in suggesting lines along which similar New England woodlands may be advantageously handled.

The first year's work in practical forestry on the 6,000-acre domain of the University of the South, at Sewanee, Tenn., has been satisfactory. The cutting advised in the working plan was carried out under the direction of an agent of the Division. It left the forest in good condition and yielded a profit at least equal to that usually earned by ordinary lumbering under similar conditions in that neighborhood.

This Bureau is now acting as the referee between the State of New York and the Moose River Lumber Company, the holder of a contract to lumber township 8, Herkimer County, N. Y., which now forms a part of the Adirondack Preserve. At the joint request of the Forest, Fish, and Game Commission of New York and the president of the company, the Division of Forestry agreed to mark the timber to be cut under this contract, and to assist in the location of lumber roads, the expense of the work to be borne by the company. This request for

what is practically a combination of arbitration and forest management is a gratifying mark of the influence of the practical field work of the Division of Forestry in the Adirondacks.

The total area of private forests actually under the management of the Bureau of Forestry is now 176,975 acres.

Of the tracts of which preliminary examination was made during the year and for which detailed working plans will be made as soon as possible, one of the most promising is that of the Okeetee Club, near Ridgeland, S. C. This consists of 60,000 acres of Longleaf Pine land in Beaufort and Hampton counties, about 30 miles north of Savannah. It presents a notable opportunity for the study of the Longleaf Pine and of the relation which fire bears to its reproduction. The fact that it is at the same time thoroughly well adapted for practical forestry makes the preparation of the working plan one of the important pieces of work to be undertaken by the Bureau.

The tract of the Moose River Lumber Company, in the Adirondacks, has been examined and a working plan recommended. That this working plan is now in preparation is significant of the growing appreciation by lumbermen and business men generally of the advantages of conservative forestry.

PUBLIC LANDS.

During the past year the Division, as rapidly as its force and its appropriation would allow, has pushed the preparation of working plans for the National forest reserves. This exceedingly important piece of work is the result of a request upon the Secretary of Agriculture from the Secretary of the Interior for technical advice regarding the management of the reserves, which comprise an area of 46,828,449 acres.

During the year the field work necessary to a working plan for the Black Hills Forest Reserve was completed. It occupied a party of 16 men for four months, and included a thorough study of the Western Yellow Pine, or Bull Pine, of local questions of lumbering, grazing, and fire, and of those conditions generally which must determine the best management of the reserve. The total stand of timber and young growth was measured upon 10,234 acres and the rate of growth of 4,500 trees was ascertained, to serve as a basis for calculations of volume and yield. The working up of these results is nearing completion. There is no other forest in the United States in which practical forestry is more urgently needed, or in which results of such importance may be more easily achieved than in the Black Hills Forest Reserve. It is practically a pure forest of Western Yellow Pine, remarkable for the abundance of its reproduction and its thorough adaptation to practical forestry. Upon its preservation depends the timber to supply a great and rapidly growing mining industry which has built up and now maintains the prosperity of this region. Its effect upon the water supply, without which mining in the Black Hills must fail, offers a most striking example of the influence of forests upon stream flow. Already vast expenditures have been made to bring from other streams the indispensable water supply formerly taken in abundance from sources which have failed since the destruction of the forest.

Examinations preparatory to working plans were made of the Prescott, Big Horn, and Priest River forest reserves, a total area of 2,249,600 acres.

Next in importance among the duties of this section to the work in

the Federal forest reserves is the preparation of working plans for practical forestry in the New York State Forest Preserve, the result of a request by the Forest, Fish, and Game Commission in the winter of 1900. The purpose of this request was to enable the commission to present to the legislature an authoritative statement of how the preserve should be handled under practical forestry and upon it to base definite recommendations.

The working plan for township 40, Totten and Crossfield purchase, Hamilton County, N. Y., was completed, and has recently appeared as Bulletin No. 30 of the Division of Forestry. It is the result of the most careful study on the ground which has ever served as the basis for a forest working plan in this country. This study shows that township 40 is fully adapted for practical forestry, and that it contains a sufficient quantity of accessible mature timber to insure profitable lumbering under conservative methods. The original forest which still covers the township includes large quantities of mature and over-mature trees, the prompt marketing of which is necessary both in order to avoid direct loss by decay and to improve the conditions of growth for the young trees, which must make the forest of the future. The working plan for township 40 outlines in detail a safe, practicable, and profitable method of lumbering the soft-wood timber, which will improve the condition of the forest, protect the sources of water supply, and leave untouched the value and beauty of the township as a public preserve. This working plan was made under a State appropriation of \$2,000 for the expenses of the agents of the Division of Forestry while in the field. During its last session the New York legislature appropriated \$3,500 more to prepare working plans for townships 5, 6, and 41. This work was begun in May of the present year and continued throughout the summer.

FOREST MEASUREMENTS.

No small part of the work of the Section of Working Plans lies in the computation of results obtained in the field by both this section and the Section of Special Investigations in its studies of commercial trees. During the year this work comprised the calculation and casting into final tables of measurements of the total stand of young and old trees on about 19,000 acres, and of the rate of growth of over 9,000 trees.

EXPENDITURES.

The total expenditures during the year by the Section of Working Plans were \$29,088.73, or 32.9 per cent of the total appropriation. Of the \$12,775 contributed by private owners as their share of the expenses in the preparation of working plans begun during the year 1900-1901, \$1,785.36 had been expended at the end of the fiscal year.

SECTION OF SPECIAL INVESTIGATIONS.

This section has a wide and increasing field. It includes many important lines of investigation, among which are studies of commercial trees, forest fires, grazing, log scales, forests and water supply, the compilation of forest histories, and the investigation of forest products. The section is confronted by a number of forest problems whose solution is of direct and urgent importance to the best development of our natural resources.

STUDIES OF COMMERCIAL TREES.

The studies of Redwood and of Red Fir and Western Hemlock, continued from last year, have been completed. These studies, which embody the results of careful and very extensive investigations on the ground, will be prepared for publication during the current year.

Incident to the preparation of a working plan for the Black Hills Forest Reserve by the Section of Working Plans, a very extensive study of the Western Yellow Pine was carried on. This study, the first made by the Division of Forestry, will form the basis for a contribution to the knowledge of a most important timber tree. The collection of similar data for this tree was begun toward the close of last year in the Prescott Forest Reserve, Arizona.

A careful study was made of the Big Tree groves in the California sierras, and their ownership was ascertained. In view of the incomplete information hitherto available for these groves, this study is of great value, both to show their comparative suitability for reserves and for the general knowledge of the tree. A number of groves, hitherto unrecorded, were examined and mapped in the course of an investigation of the northern part of the Sierra Forest Reserve.

Of the monographic studies of Red Cedar, White Cedar, and Bald Cypress, completed last year by the late Dr. Charles Mohr, that of Red Cedar is now in press. Dr. Mohr had also completed studies of eleven of the more important oaks. Frequent requests are received for precisely the information given in these unpublished monographs.

Incident to a working plan for the tract of the Sawyer and Austin Lumber Company in Arkansas, valuable data were collected for the Loblolly and Shortleaf Pines, while a thorough study of the Longleaf Pine in South Carolina was begun.

In the preparation of a working plan for a forest tract in the northern Adirondacks, the growth and habits of the Balsam were investigated. The importance of this tree for the manufacture of paper pulp is increasing steadily with the decreasing supply of spruce. A similar study of the Balsam was begun in Maine as a part of the field work necessary to the working plan for the tract of the Great Northern Paper Company.

In the preparation of a working plan for the domain of the University of the South, at Sewanee, Tenn., the study of the important hardwoods of that region was well begun; while a large number of measurements were obtained for White Ash, Hickory, Cow Oak, and White Oak, during the making of a working plan for the tract of the Deering Harvester Company in Missouri.

Incident to a working plan for a tract in Massachusetts an important study of the second-growth hardwoods of that region was begun, and has been extended widely during the year over second-growth lands in other portions of New England.

COOPERATIVE WORK.

In cooperation with the U. S. Geological Survey, a study was made of the region of the proposed Appalachian Forest Reserve. This investigation was specifically authorized by Congress and had for its object to ascertain the suitability of the region examined for a National forest reserve, the probable cost of such a reserve, and to consider the direct and indirect returns under practical forestry. One of the important results of the work is a map, showing the woodland, tim-

berland, and agricultural and other lands within the area of 9,600,000 acres examined.

An examination of 3,049,120 acres in the Sierra Forest Reserve was made, also in cooperation with the U. S. Geological Survey. Special attention was given to the kind, quality, distribution, and stand of the forest trees. The effects of lumbering, fire, and sheep grazing on the forest were also noted. A map which accompanies the report shows the distribution of forest and other lands, the density of the forest, and the location of lumbered, burned, and grazed areas.

FORESTS OF NEBRASKA AND TEXAS.

An extensive investigation of the present forest condition of Nebraska was begun and carried far enough to demonstrate the practical feasibility of replanting large areas hitherto believed to be permanently treeless.

An elaborate report on the forests of Texas was completed and will be published during the coming year.

STUDY OF SHEEP GRAZING.

During the season 12 of the Federal forest reserves were examined with special reference to the effects of grazing on the forest. The result of this work was to develop, in harmony with the conclusions reached after similar study in the past, a workable system of proposed regulations, whose enforcement would sustain equally the welfare of the forest, of the uses of water, and of the grazing interests.

STUDIES OF VARIOUS FOREST SUBJECTS.

Forest fires.—An extended study on the ground was made of forest fires and reproduction in the North Park and Medicine Bow Mountains of Colorado. Special attention was given to this subject in the reserves of Arizona, California, Oregon, Washington, and Wyoming.

In the historical study of forest fires, records of about 1,800 fires were added during the year, bringing the total number recorded to over 10,000.

Forest history.—Histories of lumbering in Mississippi, Louisiana, and Texas were undertaken, and that of New York was pushed far toward completion.

Log scales.—The first volume of the Woodman's Handbook is nearing completion. It contains information useful to foresters, forest students, lumbermen, and laymen. A feature of the preparatory work for the Handbook is an exhaustive collection of American log scales, with a discussion of their comparative accuracy.

Forest products.—A useful report has been prepared on the maple-sugar industry. It deals with the history and distribution of the industry and with methods of manufacture of the pure and unadulterated product.

FOREST EXHIBITS.

The forest display installed at the Paris Exposition in the spring of 1900 remained on exhibition during the remainder of that calendar year. The general purpose of the exhibit was to illustrate the relation of forests to agriculture. Its most notable part consisted of 92

transparencies, bromide enlargements, and maps, some of the first being the largest glass pictures ever made. The exhibit was awarded a gold medal.

The forest exhibit of the Department of Agriculture at the Pan-American Exposition was prepared in the Division of Forestry, and was installed by June 20, 1901. It consisted chiefly of colored transparencies and bromide enlargements and maps, and illustrated the general progress and condition of forestry and forests in the United States.

MISCELLANEOUS.

Much attention was given during the year to the photographic collections and to the identification of botanical specimens submitted by the various Divisions, by the National Museum, and by several State experiment stations.

With the Bureau of Plant Industry, a plan for labeling trees on the grounds of the Department was devised, a list of names was supplied, and attention was given to the placing of the labels.

EXPENDITURES.

The total expenditures of the Section of Special Investigations were \$21,616.73, or 24.4 per cent of the total appropriation.

SECTION OF TREE PLANTING.

There has been notable development in the work of this section during the year. The plan of cooperative planting when first announced drew many applications for small tracts, principally in the prairie States. The practical assistance given in these cases and the better understanding of the purpose and results of economic tree planting have since drawn applications from a wider territory and for larger tracts. Owners of unprofitable cleared or treeless land are beginning to see in the cooperation offered by the Bureau a means of rendering their lands valuable, and are applying for assistance in planting.

The proof given by examples on the ground that commercial plantations are profitable in the Middle West has started a movement toward large plantations of timber for the production of fence posts, telegraph poles, and railroad ties. Private landowners are entering this work in increasing numbers every year. Several railroad companies are seriously considering large plantations of forest trees, and are already in consultation with the Bureau.

The study of the encroachment of forests on the plains has already shown that portions of the semiarid public lands, wholly unfit for farming and of little value for grazing, can be forested at reasonable expense. If further investigation shows that large areas of such land can be reclaimed in this way, as it seems altogether likely to do, a vast field will be opened for useful work.

COOPERATIVE TREE PLANTING.

The applications for assistance in forest planting numbered 148 for the fiscal year; 46,145 acres were examined and detailed planting plans were prepared for 5,785 acres. The greater number are for small tracts. There is a conspicuous increase in the number of large tracts for which planting plans are asked. Applications are on file

for several tracts of over 5,000 acres each. In other instances the planting begun on small areas will be extended over hundreds and even thousands of acres as rapidly as the facilities for planting will permit. Requests have been received for planting plans for commercial plantations in the treeless plains, for the production of fence posts, telegraph poles, and railroad ties. Fertile agricultural land is employed for these purposes, there being no longer any question that such land can, under certain conditions, be used as profitably for a forest as for an agricultural crop.

For all this planting the Bureau of Forestry furnishes direction and advice. The planting material and the necessary labor are invariably furnished by the owners.

STUDIES OF PLANTED WOODLANDS.

Forest measurements were made in 32 of the largest commercial plantations in Nebraska, Iowa, South Dakota, and Kansas, including the Hummewell, Munger, and Yaggy plantations, and that of the Kansas City, Fort Scott and Memphis Railroad. These results are of the highest value, not merely in showing the growth of some plantations in these regions, but especially because they exhibit also the profitable nature of these undertakings. A bulletin embodying the results of these studies is in preparation.

FOREST ENCROACHMENT ON THE PLAINS.

This investigation, tentatively begun a year ago, was continued in nearly all the States of the Great Plains. The immense area to be covered will make the investigation a long one, but it has already yielded important information on tree planting in many localities. The work was done mainly in connection with the field work for cooperative tree planting and the studies of planted woodlands, but in May, 1901, a careful investigation was begun in Nebraska to determine the possibility of reclaiming portions of the nonagricultural public lands by judicious planting, and by protection from fire and grazing. This study was carried far enough to show that portions of the sand hills, heretofore considered almost worthless, can be forested with valuable timber at comparatively small expense.

Much attention was given during the year to the spread of information on tree planting. Circular No. 22 was revised and enlarged, and more than 10,000 copies were sent out. A Farmers' Bulletin, "Tree planting on rural schoolgrounds," was prepared and submitted for publication. Forty mimeographed circulars giving directions for the planting and care of various species of forest trees were prepared, and a special mailing list of 2,000 names was compiled. Public lectures, illustrated with lantern slides, were frequently given by the members of the section while in the field.

EXPENDITURES.

The expenditures for the Section of Tree Planting during the year were \$9,523.61, or 10.8 per cent of the total appropriation.

SECTION OF OFFICE WORK.

PERSONNEL.

On July 1, 1900, the number of employees in the Section of Office Work was 14. During the year this number was increased by the

appointment of 3 stenographers, a property clerk, 2 library assistants, 2 photographers, 2 laborers, and 2 charwomen, being a total of 26 employees in this section at the close of the fiscal year.

In addition to the above, the Section of Office Work carried on its rolls an accountant, who was assigned to duty with the division of accounts.

The total amount expended for salaries in this section was \$19,233.39.

LIBRARY.

The main collection of forestry literature still remains in the Department Library, as the quarters assigned for the library of the Bureau are inadequate to store this collection. Only such works, therefore, as are most frequently referred to are kept in the Bureau library. There are at present 110 bound volumes and 1,300 pamphlets in the Bureau collection. During the year 3,200 newspaper clippings were purchased, and these have been numbered, classified, indexed, and filed. A large part of the old subject index has been revised and copied, and, in addition, 15 French, German, and English periodicals have been regularly indexed. A file has been kept of all Congressional bills, acts, documents, and reports bearing on forest topics.

The photograph collection of the Bureau numbers 4,968 prints, of which 2,000 have been fully described, labeled, and classified, and are ready to be catalogued; 567 lantern slides were added to the collection. A special case has been made to hold the slides, and they will be arranged to correspond with the photographs. During the past year the library staff was too limited to record properly the mass of collected material, but it is expected that during the coming year complete records will be kept, all the accumulated material catalogued, and current accessions regularly disposed of.

ACCOUNTS.

The following statement, prepared by the accountant, gives the expenditures in the different sections of the Division for the fiscal year July 1, 1900, to June 30, 1901:

Expenditures for fiscal year 1900-1901.

Section.	Salaries.			Expenses.			Total expenditure.	Per cent of total appropriation.
	Amount.	Per cent of total salaries.	Per cent of total appropriation.	Amount.	Per cent of total expenditures.	Per cent of total appropriation.		
Chief of Division.....	\$2,500.00	3.9	2.8				\$2,500.00	2.8
Working plans.....	22,933.02	35.9	25.9	\$6,155.71	24.9	7	29,088.73	32.9
Special investigations.....	14,180.38	22.2	16	7,436.35	30.2	8.4	21,616.75	24.4
Tree planting.....	5,022.48	7.9	5.7	4,501.13	18.3	5.1	9,523.61	10.8
Office work.....	17,136.43	26.8	19.4	2,338.43	9.5	2.6	19,474.86	22
Photographs.....	2,096.96	3.3	2.4	1,880.13	7.6	2.1	3,977.09	4.5
Instruments.....				2,338.98	9.5	2.6	2,338.98	2.6
Total.....	\$63,869.27	100	72.2	24,650.73	100	27.8	\$88,520.00	100

^a The large percentage of the total appropriation paid for salaries requires explanation. The proportion between 72.2 per cent paid for salaries and 27.8 per cent paid for expenses does not represent the relative importance of field and office work in the activity of the Bureau. A very considerable part of the field expenses was met by the contributions of owners of forests for which plans were made. It should be remembered also that the cost of computing the field results, which appears wholly under the heading of salaries, is necessarily very great.

CORRESPONDENCE AND PUBLICATIONS.

Close attention was given to the prompt handling of correspondence. With few exceptions action was taken and acknowledgment made within forty-eight hours after the receipt of any communication. The increase in the amount of correspondence recorded for the previous fiscal year was maintained. The correspondence for the year numbered 15,051 letters, as against 8,800 for the preceding year.

During the year there were published three bulletins (25,000 copies), two extracts from Yearbook (30,000 copies), the Report of the Forester for 1900 (8,000 copies), and six press bulletins (19,100 copies), a total of 82,100 copies. In addition there were reprinted 1,000 copies of Bulletin No. 22; 4,000 of Bulletin No. 28; 2,000 of Circular No. 12; 2,000 of Circular No. 21; and 22,000 of Circular No. 22, to which should be added a Congressional reprint of Bulletin No. 24, "A Primer of Forestry, Part I" (35,000 copies), of which 20,000 copies were placed at the disposal of the Division of Forestry. There were distributed in all 81,575 copies.

MAILING LIST.

In the early part of the fiscal year a radical change was made in the manner of distributing bulletins. Because of the largely increased demand, it was decided to forward them only upon application. Notices of their appearance, with brief descriptions, are now sent to those persons whose names are on the mailing list of the Bureau, and applications are honored in the order of their receipt. The annual report of the Forester, the circulars of the Division, and the reprints of its contributions to the Yearbook of the Department are sent to all addresses on the mailing list, as heretofore.

PHOTOGRAPHIC LABORATORY AND FIELD INSTRUMENTS.

At the beginning of the fiscal year the photographic laboratory was placed in a satisfactory working condition, and excellent work was done throughout the year; 4,778 films and plates were developed; 6,632 prints were made, and altogether 16,474 items of work were performed.

During the year the supply of field instruments was largely increased, the total amount expended for this purpose being \$2,338.98. At the beginning of the present fiscal year the Bureau was well furnished with the tools necessary for its work in the field.

QUARTERS.

On May 1, 1901, the Division was removed to more commodious and satisfactory quarters in the Atlantic Building, 930 F street NW.

EXPENDITURES.

The expenditure for the Section of Office Work during the year was \$28,290.93, or 31.9 per cent of the total appropriation.

WORK FOR THE ENSUING YEAR.

FOREST MANAGEMENT.

PRIVATE LANDS.

It is expected that working plans will be completed for 5 timber tracts, upon which field work has already been begun. These tracts

have a total area of 628,000 acres. A working plan for the 60,000-acre tract of the Okeetee Club, near Ridgeland, S. C., will be begun in the early winter.

Preliminary examinations will be made of about 1,000,000 acres of Longleaf Pine land in Texas, 50,000 acres of Longleaf Pine land in South Carolina, 16,000 acres of hardwood land in North Carolina, 60,000 acres of hardwood land in Tennessee, 10,000 acres of Shortleaf Pine land in Georgia, and 17,000 acres of second-growth hard wood land in New York, and will be followed by working plans for some of these tracts. As many other examinations as possible of private forest lands, for which assistance has been requested, will be made. It is intended to devote more attention to the study of wood lots than has been practicable during the past year.

PUBLIC LANDS.

Preliminary examinations will be made of 4 of the Federal forest reserves, and the field work incident to working plans will be begun upon at least 2 of them. Plans already in preparation will be continued or completed.

INSPECTION.

Markings and inspection of lumbering will continue upon those tracts in the Adirondacks which are under the oversight of the Bureau, upon the 6,000-acre domain of the University of the South, at Sewanee, Tenn., and upon a 14,000-acre tract near Lenox, Mass. Markings and inspection will be begun upon the 14,000-acre tract of Mr. E. H. Harriman, in New York, and upon other lands for which they are requested and advised in working plans already prepared.

COMPUTATION.

An effort will be made to complete the working up of all field results obtained during the year. The quantity to be handled exceeds considerably that of the fiscal year 1900-1901.

FOREST INVESTIGATION.

STUDIES OF COMMERCIAL TREES.

Studies of important hardwoods will be carried on in the Smoky Mountains and the Cumberland Plateau. The investigation of second-growth hardwoods in New England and of Balsam in Maine will be continued, while a study of the White Pine in Michigan will be begun. Western Yellow Pine will be studied in South Dakota and Arizona, and Sugar Pine and the Bristle-Cone Fir in California.

Monographic studies of Southern timber trees will be continued, and will include the hickories, additional important oaks, ashes, elms, beech, chestnut, tulip poplar, lindens, and sweet gum.

STUDIES OF NORTH AMERICAN FORESTS.

Forest distribution in Nebraska, Colorado, and Montana will be investigated. The study of the influence of forest cover on the run-off of streams, begun in southern California during the last fiscal year, will be continued.

At the request of the Michigan State Forest Commission a study

will be made of State forest lands in Michigan, in order to devise a plan for their management. The forests of the Sacramento Mountains of New Mexico will be studied on the ground.

GRAZING.

Studies of the effect of grazing on the forest will be continued in Wyoming (Yellowstone Timberland Reserve and Teton Forest Reserve), in southern New Mexico (Sacramento Mountains), in the southern and central California forest reserves, and in Montana.

STUDY OF FOREST PRODUCTS.

In cooperation with the Bureau of Chemistry, important investigations will be begun of native trees of the United States and Philippine Islands yielding commercial tan barks, resins, and gums. About fifty species will be studied during the year. The recent establishment in the Bureau of Chemistry of a dendro-chemical laboratory makes this investigation possible.

A study will be made of the production of commercial resins by Southern pines, particularly of the Longleaf Pine, and an effort will be made to devise an improved method of tapping. The need of a less destructive method than the one now in use is greatly felt.

An investigation of the supplies of railway timber available from forest plantations, especially in the Middle West, will be undertaken. Special attention will be given to the study of timber trees producing railway ties in the shortest time.

A study of the conditions, causes, and prevention of decay in railroad and other timber will be undertaken on a large scale in collaboration with the Bureau of Plant Industry. This is work of the first importance.

COOPERATIVE WORK.

Forest descriptions will be made of additional areas in the region of the proposed Appalachian Forest Reserve, and in the southern portion of the Sierra Forest Reserve of California, in cooperation with the U. S. Geological Survey.

A preliminary forest description and study of important forest problems are to be undertaken in Vermont.

In cooperation with the Maryland geological survey forest descriptive work will be continued covering 4 of the best timbered counties of the State.

STUDY OF FOREST FIRES.

Studies of forest fires will be made this year in Wyoming, California, New Mexico, Idaho, Michigan, Maine, and other States.

The collecting of forest-fire records will be continued, and will include the examination of a large number of Western papers.

PROPOSED INVESTIGATIONS.

Other lines of investigation which will be undertaken, if the resources of the Bureau will permit, are as follows:

A study of various woods, with a view to determining those suitable for the manufacture of excelsior.

Studies and experiments to show the fuel value of various woods as compared with that of hard and soft coals.

TREE PLANTING.

Extensive forest measurements will be made in the planted woodlands of New England and the Eastern States, and additional facts will be collected in the plantations already studied in the Middle West. The study of forest encroachment on The Plains will be continued, with Nebraska as one of the principal fields. As many preliminary examinations for planting plans as possible will be made. Some of the applications are for very large tracts, notably one of 8,000 acres in Wisconsin and one of 160,000 acres in Washington. The demand for work in tree planting has already far outgrown the resources of the office, and is still increasing.

REPORT OF THE STATISTICIAN.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF STATISTICS,
Washington, D. C., November 4, 1901.

SIR: I have the honor to submit herewith a report of the work of the Division of Statistics for the fiscal year ended June 30, 1901.

Respectfully,

JOHN HYDE,
Statistician.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

With a smaller appropriation available for its work than was expended for a like purpose in any fiscal year from 1891 to 1898, inclusive, the Division of Statistics has endeavored to meet the ever-growing demand for statistics of the agricultural industry. It handled during the fiscal year nearly 2,500,000 returns from a corps of correspondents numbering about 250,000, the results appearing in 13 ordinary and 6 special reports, of which over 1,500,000 copies were printed.

The work has consisted largely, as in past years, of the preparation of reports relative to the principal products of the soil, including the extent and geographical distribution of the area of production, the condition and prospects of the crop during the growing season, and the quantity, quality, and disposition of the product harvested. These reports, together with the latest information concerning the crops of foreign countries and other statistical matter of general interest, have been published in the monthly Crop Reporter. Of this publication there were printed during the year a total of 1,434,000 copies. This number was utterly inadequate for the requirements even of the Department's statistical correspondents, and I earnestly recommend the printing of at least 250,000 copies of each future issue. The Department's statistical correspondents render most valuable service without compensation, and while the impracticability of printing special reports in sufficiently large editions to permit of their general distribution among so numerous a body of men is fully recognized, correspondents should surely be given a publication embodying with the results of their own work so much other timely information of interest and value to them.

SPECIAL REPORTS.

The special reports prepared or issued during the year comprise the following: "The course of prices of farm implements and machinery for a series of years," by George K. Holmes; "The cotton crop

of 1899-1900," by James L. Watkins; "Wheat growing and general agricultural conditions in the Pacific coast region of the United States," by Edwin S. Holmes, jr.; "The cereal crops of European Russia in 1900," by E. T. Peters; "Rates of charge for transporting garden truck, with notes on the growth of the industry," by Edward G. Ward, jr., and Edwin S. Holmes, jr.; and "Wages of farm labor in the United States." Of these publications there were printed 93,000 copies, making the total number of copies of publications issued by this Division during the year 1,527,000, not including the reprint of the article on the "Influence of rye on the price of wheat," by E. T. Peters, which appeared in the Yearbook of the Department for 1900, nor the reprint of the statistical appendix to the Yearbook, which is mainly the work of the experts of this Division.

A SPEEDIER DISSEMINATION OF INFORMATION.

For several years past determined efforts have been made, with the cooperation of the Public Printer, to expedite the publication and distribution of the monthly crop reports, so that as little time as possible might intervene between the issue of the telegraphic summary and the receipt in the most remote agricultural county of the complete report. On May 31, 1901, however, at a time when the keenest interest was prevailing throughout the entire South as to the extent of the newly planted acreage of cotton, a card containing the most important points of the Statistician's report on the subject was mailed to 24,000 post offices in the Southern States within three hours of the publication of the telegraphic summary, with a request that postmasters would give it prominent display in their offices. This was done largely as an experiment, and so successful was it that within a few weeks its operation was extended, with the most gratifying results, to the grain reports. A farmer has now only to visit the nearest post office to see the Statistician's latest report on the principal crops, and the measures adopted by the Public Printer and the Postmaster-General have reduced to a minimum the time necessary for placing this important information within the farmer's immediate reach.

To attain this result the cards are addressed before they are printed, and the reading matter, with the exception of the actual figures of the report, is put into type. A branch printing office is established in a private room connecting with that of the Statistician, and as rapidly as the official figures are arrived at they are inserted in the card. This is all done within the hour preceding the issue of the telegraphic report, and during that time no employee having access to the figures is allowed to leave the building or have communication with anyone outside. Promptly on the first stroke of the hour—12 at noon in the case of cotton, and 4 p. m. in that of grain—a summary of the report is handed to special operators of the Western Union and Postal Telegraph Cable companies, representatives of the press, and other applicants, and only a few moments elapse before it is being read in all the commercial centers of the world. Concurrently with the official promulgation of the figures the printing presses are set in motion, and almost as fast as they leave the press the cards for display in the 77,000 post offices of the country, previously arranged by States, and ranging in number from 149 for Rhode Island to 5,255 for Pennsylvania, are sent to the Washington post office, where special provision is made for their prompt dispatch.

FOREIGN CROP INTELLIGENCE.

The importance to the American farmer and to the country in general of trustworthy information concerning the crops of competing countries, and especially that of wheat, needs no demonstration. Regulate the extent of the wheat acreage in the United States as we will, improve the facilities for the transportation of the grain as we may, the price of this product must inevitably continue to depend largely on the production of other countries, the contribution of the United States to the wheat production of the world having rarely reached and but once exceeded 25 per cent of the whole.

While the cultivation of friendly relations with the statistical offices of foreign Governments has secured for the Department during the last two years facilities for reporting upon foreign crops superior to those in its possession at any previous period in its history, the need has been felt of a still more prompt transmittal to this office of authoritative information relative to the condition and prospects of such crops as enter into competition with those of the United States in the world's markets.

Negotiations with the Governments of various important grain-producing countries of Europe, and also with that of the Dominion of Canada, looking to a telegraphic interchange of crop reports similar to that already in operation between the United States and Hungary, were entered upon during the closing days of the fiscal year covered by this report, and it is not an improper anticipation of the Statistician's report for the year 1901-1902 to state that those negotiations have now reached a stage at which it can be stated with almost absolute certainty that the growing season of 1902 will see the American farmer placed in as prompt possession of reliable statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

DEMAND FOR ENLARGEMENT OF SCOPE OF WORK.

There is an urgent demand from many different directions for a substantial broadening of the scope of the work of this Division. Only the insufficiency of the appropriation prevents the live stock and live-stock products of the country—an interest so enormous that after satisfying the needs of our own large population there was available last year for export over \$250,000,000 worth of its products—from being reported upon as promptly and fully as are the cotton, corn, and wheat crops of the country. The annual fruit crop, the egg and poultry industry, beet sugar flaxseed, and other products of great and growing importance also claim attention. The Department has already in operation all the agencies necessary to the collection, as often as may be necessary, of the required information relative to these important interests, and all that remains to be done is to provide the means for the employment of such additional experts and statistical compilers as may be necessary to the prompt compilation and analysis of so large an amount of additional statistical data.

NEED OF A BUREAU ORGANIZATION.

Attention is once more invited to the fact that the statistical work of the Department has far outgrown that divisional organization which was formerly entirely adequate to its requirements, but is now greatly

restricting its usefulness. Few Government bureaus, civil or military, have their operations extending, as has this office, into the remotest and most sparsely populated civil divisions of the country. Were the correspondents employed in the collection of crop intelligence paid a fair rate of compensation for the service they render, the cost of maintaining an organization five times as numerous as the census enumerators would call attention, as probably nothing else will, to the magnitude of the Department's statistical service. But the fact that the reports upon which the work of the Division of Statistics so largely depends are made without compensation in no wise diminishes the amount of labor involved in their compilation and analysis; indeed, the list of correspondents is more difficult to keep up to the necessary standard in number, if not in quality, than it would be if it consisted of persons adequately remunerated for their services. The new directions in which the work of the Division might be made of service to the agricultural interests of the country if its organization were made more elastic by its conversion into a bureau and the appropriation for its maintenance were made more adequate to its needs are so numerous that an addition of \$50,000 to the present appropriation would not be an excessive provision for the new work that could at once be undertaken.

THE STATISTICAL LIBRARY.

While there is no branch of statistics having any close relation to the agricultural industry that is not more or less adequately represented in the Department's statistical library, as regards the literature of prices it is believed to be the best equipped library in the country, and no reasonable expenditure that may be necessary to maintain its present high standard should be withheld. Its card index to agricultural statistics is also pronounced by visitors who have occasion to consult it to be exceptionally complete and well arranged, and reasonable provision for its continuation is recommended.





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